EXAMINING INTERPRETATION TRAINING FOR THOUGHT-ACTION-FUSION: A PLACEBO-CONTROLLED RANDOMIZED EXPERIMENTAL TRIAL

by

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ABSTRACT

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Found in many emotional disorders, thought-action fusion (TAF) is a distorted cognitive belief that simply having an upsetting intrusive thought can increase the chance of the associated event occurring (TAF Likelihood) or represents a person's morality (TAF Morality). Challenging these beliefs through cognitive bias modification for interpretations (CBM-I) has been shown to modify negative interpretations, reduce TAF belief, and reduce associated distress. Our previous study (Siwiec, Davine, Kresser, Rohde, & Lee, 2017) showed that an active CBM-I developed to challenge TAF beliefs (TAF-INC) outperformed a control condition (TAF-CON) in reducing TAF belief, distress, and associated symptoms. The current study examined whether a single session of TAF-INC can outperform both TAF-CON, as well as a credible comparison condition, stress management psychoeducation (SMP). Fifty-seven non-clinical participants were randomized to either: (i) an active condition (TAF-INC), (ii) a control condition (TAF-CON), or (iii) a credible psychological comparison condition (SMP). SMP is part of many cognitive interventions for OCD and other anxiety disorders and has been shown to reduce obsession symptoms. Results from this study indicated that at post-training the TAF-INC condition experienced greater reductions in TAF scores, primary obsessions, and general distress than TAF-CON or SMP. At the 1-month follow-up the TAF-INC condition did not display consistently greater reductions than the other conditions. Results of the study are discussed in terms of the cognitive theory of obsessional thoughts, and future research directions are suggested.

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Cognitive models of emotional disorders (anxiety and unipolar depression) have emphasized the crucial role that biased information processing plays in the development and maintenance of emotional psychopathology (Beck & Clark, 1997; Eysenck, 1992; 1997; Salkovskis, 1985, 1989; Williams, Watts, MacLeod, & Mathews, 1997). Extensive research programs generated by these models have demonstrated that anxious and depressed individuals are characterized by particular types of interpretive (e.g. thought-action fusion), attentional, and/or memory biases when processing affective material (cf., Mathews & MacLeod, 2005). A cognitive bias refers to the tendency to give priority in processing to negative or threatening information, via rapid assignment of negative or threatening appraisals to ambiguous information (Mathews & MacLeod, 2005; Williams, Blackwell, Mackenzie, Holmes, & Andrews, 2013; Williams et al., 1997). Generally, there is growing research to support the hypothesis that cognitive bias precede and predict variability in negative emotional reactions to later stressful life experiences (Amir, Beard, & Bower, 2005; MacLeod & Hagan, 1992). While patterns of selective information processing are also shown in nonclinical individuals (e.g., Williams et al., 1997), by attributing causal status to cognitive bias in the etiology of emotional psychopathology, such models implicate selective processing in the explanation of clinical anxiety and depression. This line of reasoning also identifies such biases as major targets for therapeutic intervention (Clerkin & Teachman, 2011; Clerkin, Magee & Parsons, 2014; Steinman & Teachman, 2010; Zucker, Craske, Barrios, & Holguin, 2002).

Thought-Action Fusion

Thought-action fusion (TAF) is a prominent and important cognitive bias by which individuals with obsessional difficulties place undue significance and meaning to their thoughts (e.g. magical thinking, over-responsibility), and believe their thoughts can increase the probability of feared events occurring (Foa, et al., 2002; Frost & Steketee, 2002; OCCWG, 1997; Shafran, 2004). Intrusive thoughts

(e.g. repulsive, horrific, aggressive, or dangerous) are a normative experience and not necessarily pathological (Rachman & de Silva, 1978), with up to 90% of non-clinical individuals reporting their occurrence (Rachman & de Silva, 1978). In individuals with clinical disorders, such as obsessive-compulsive disorder (OCD), intrusive thoughts are more frequent, intense, and perceived as more uncontrollable (Clark & Inozu, 2014). Additionally, these individuals are more likely to misinterpret the presence and/or meaning of these thoughts as significant and revealing of their hidden dark nature, especially if the frequency of intrusions increases (Rachman, 1997). The disruptive interpretation that thoughts are equivalent to acts and/or can cause real life outcomes, tied with a sense of personal responsibility for the thoughts occurring, compels the individual to try and stop any associated feared outcome associated with the thought (Shafran, Thordarson, & Rachman, 1996). Thus, the individual feels motivated to engage in behaviors intended to actively resist the thoughts (i.e. thought suppression), and/or utilize rituals intended to decrease any anxiety or anticipated harm associated with the thought (i.e. warning their friend of a possible car crash) (Abramowitz, Whiteside, Lynam, & Kalsy, 2003). In OCD specifically, this cognitive error pattern is considered to be an important process in forming and maintaining the disorder (Rachman & De Silva, 1978; Rassin, Cougle & Muris, 2007).

TAF can be broken down into the subtypes *Moral* (TAF-M) and *Likelihood* (TAF-L). TAF-M refers to an individual's belief that experiencing an unacceptable thought is as bad as carrying out the associated action (Shafran et al., 1996) (e.g., "*Thinking of adultery is as bad as actually engaging in it*"). TAF-L refers to the belief that having an intrusive and distressing thought about an event increases the chances this event will come true (e.g., *Thinking about a good friend developing cancer will increase the likelihood that it will occur*) (Berle & Starcevic, 2005; Rachman, 1997; Shafran, 2004; Shafran et al., 1996). TAF-M and TAF-L are conceptually distinguished but are inter-related constructs (Berle & Starcevic, 2005), as findings by both Shafran et al. (1996), and Rassin, Merkelbach et al. (2001) demonstrated that the two factors are moderately correlated (r=0.44 and r=0.32 respectively). This is logical, as the content of many intrusive thoughts may contain both TAF-M and TAF-L; while each individual's belief in either TAF-M or TAF-L may differ. Research findings have supported that TAF-L

can be further divided into TAF-Likelihood Others (TAF-LO) and TAF-Likelihood Self (TAF-LS) (Bailey, Wu, Valentiner, & McGrath, 2014). TAF-LO refers to the increased likelihood of a negative event occurring to *others*, while TAF-LS refers to the increased likelihood of a negative event to *oneself*. Both TAF-LO and TAF-LS have displayed associations with psychopathology, even in non-clinical populations (Rassin et al., 2001). Thus, when looking at student or community samples it is important to represent TAF-LS and TAF-LO.

TAF in OCD and Various Disorders

Beck and Clark (1997) proposed that pathological anxiety may develop when individuals "inappropriately generate threat meaning assignments to innocuous stimuli" (p. 51). In individuals with elevated anxiety, including OCD (Rachman, 1993), research has consistently found that interpretation biases have a focus toward threats (Mathews & MacLeod, 2005). Therefore, it is not surprising that TAF bias has been found in clinical and subclinical samples where individuals interpret danger/threats when presented with ambiguous information, such as OCD (Amir et al., 2001; Muris et al., 2001; Thompson-Hollands et al., 2013), generalized anxiety disorder (GAD; Muris et al., 2001), schizotypy (Lee et al., 2005, Muris and Merckelbach, 2003), schizophrenia (Kabakci, Demir, Demirel, & Sevik, 2008), disordered eating (Shafran & Robinson, 2004), and depression (Abramowitz et al., 2003; Hossein et al., 2012; Muris et al., 2001; Rachman et al, 1995, Rassin et al., 2001; Shafran and Rachman, 2004).

Although TAF displays influence in various disorders, its strongest influence is with OC symptoms (Muris et al., 2001). A recent study by Meyer and Brown (2013) of the psychometric properties of the Thought-Action Fusion Scale (TAFS; Shafran et al., 1996), a validated measure of TAF, found in a clinical outpatient sample (n=700) that TAFS total scores were more strongly related to OCD symptoms than to either worry or depression. Moreover, TAFS total scores have consistently displayed an association with OC symptoms in the mild to moderate ranges (0.20 to 0.38; Gwilliam et al., 2004, Rassin et al., 2000; Rassin, Diepstraten et al., 2001; Rassin & Koster, 2003; Rassin, Merkelbach, Muris, & Spaan, 2001; Shafran et al., 1996).

How TAF contributes to OCD

Cognitive models of how TAF is thought to contribute to obsessional symptoms explains that those high in TAF bias tend to make attributions of both inflated responsibility and an evil nature to their obsessional thoughts (Salkovskis, 1985; Shafran et al., 1996). Consequently, individuals who believe their intrusive thoughts are representations of their true dark natures are likely to experience increased distress when these thoughts occur. These individuals are thus more likely to engage in various covert thought control strategies to reduce the impact of the thought, such as thought suppression. In those who hold TAF bias, actions to suppress intrusive thoughts are understandable as the individual feels personal responsibility for the occurrence of the intrusive thoughts (Berle and Starcevic, 2005). Paradoxically, the use of thought suppression could result in more frequent intrusions and an escalation into pathological obsessions (Najmi, Riemann, & Wegner, 2008; Wegner, 1989; Wegner, Schneider, Carter, & White, 1987). This process is thought to influence the development and maintenance of OCD (Rachman & De Silva, 1978; Rassin, Diepstraten, et al., 2001; Rassin et al., 2007). As Wegner (1989) explained, "an obsession can grow from nothing but the desire to suppress a thought" (p. 167). Rassin, Diepstraten, et al., (2001) emphasized that thought suppression can be conceptualized as a form of neutralization activity used to ease or nullify the distress brought on by an intrusive thought (e.g. praying, confessing, reassurance seeking, and superstitious rituals). It has been hypothesized that utilizing this method of harm avoidance is an extension of the tendency to fuse thoughts with real-life events (Amir, Freshman, Ramsey, Neary, & Brigidi, 2001), thus tying it directly to TAF. Findings by Rassin, Merckelbach, Muris, and Spaan (1999) and Rassin et al., (2000) used structural equation modeling to support that TAF may play a causal role in the development and maintenance of intrusive thoughts, even among undergraduates. Results supported a model in which TAF leads to attempts at neutralization via thought suppression, which in turn predicts *more* OC symptoms. These findings are in line with recent research which indicates that individuals higher in OC belief tend to utilize poorer coping strategies in response to intrusive thoughts (avoidance, neutralization, prayer) than those with lower levels of OC beliefs (Levine

& Warman, 2016). Consequently, those with higher OC beliefs are in need of targeted interventions that provide understanding and teach healthier responses to intrusive thoughts.

Evoking and Reducing TAF

Both cognitive theory and recent research suggests that TAF likely contributes to the maintenance of OCD; therefore, cognitive interventions designed to reduce TAF are expected to reduce symptoms related to intrusions in the disorder (Rassin, Diepstraten, et al., 2001). As Rachman (1997) states, "It follows from the theory that the most direct and satisfactory treatment of obsessions is to assist patients in modification of putatively casual catastrophic misinterpretations of the significance of their intrusive thoughts. Bluntly, if these misinterpretations are 'corrected', the obsession should cease" (p. 799).

Research using a "sentence completion paradigm" has reliably been able evoke TAF-relevant negative interpretations of intrusive thoughts (Clerkin & Teachman, 2011; Rachman, Shafran, Mitchell, Trant, & Teachman, 1996; van den Hout, van Pol & Peters, 2001), which suggests that TAF can be experimentally manipulated to be increased at least temporarily. In this sentence completion paradigm participants are asked to think of a close friend or loved-one, then insert the name of that person into a sentence designed to elicit OC-relevant intrusive thoughts, and then visualize it occurring (e.g. *I hope ____ is in a car accident*). Findings indicated that this task evoked substantial increases in anxiety, guilt, and feelings of responsibility in participants.

Research also indicates that TAF can be reduced, as findings from cognitive behavioral therapy (CBT) for OCD show that TAF reliably decreases from pre-treatment to post-treatment (Jonsson, Hougaard & Bennedsen, 2011; Rassin, Diepstraten, et al., 2001; Shafran & Rachman, 2004). Moreover, findings by both Marino-Carper et al., (2010) and Zucker et al., (2002) found that utilizing brief (one paragraph) anti-TAF psychoeducation before the sentence completion paradigm, which was used as a TAF stressor task, resulted in a significant reduction in TAF subscale scores from pre-task to post-task (between 20% to 30% reduction in the TAF scores), and prevented some anxiety and urges to neutralize elicited by the task. Although these findings indicate that TAF can be reduced by directly disputing its erroneous nature, reductions are relatively minor in amount and are potentially attributable to utilizing a

training modality of persuasion rather than training new interpretations. If TAF can be noticeably reduced using very brief psychoeducation, there is potential that a more potent training modality may have a larger effect.

Cognitive Modification for Biased Interpretations

An area of research gaining favor in anxiety disorders treatment is cognitive bias modification (CBM). CBM is a cognitive experimental methodology that works by modifying a participant's biases theorized to contribute to maintaining the psychopathology by training healthier responses to ambiguous but potentially threatening cues (MacLeod, 2012; Williams et al., 2013). For example, an often-employed procedure in CBM is the word completion task, which was developed to induce interpretation biases from participants. The task involves presenting individuals with a series of ambiguous scenarios that they are forced to repeatedly resolve in either a negative or positive manner, by solving an incomplete word fragment important to understanding the scenario (Grey & Mathews, 2000). In OCD, implementing a word completion task is designed to have participants imagine themselves in scenarios intended to elicit OC-relevant interpretation and reactions (Beadel, Smyth & Teachman, 2014; Clerkin & Teachman, 2011; Williams & Grisham, 2013). In the active training condition, participants are presented with relevant obsessional thoughts, and then presented with a sentence reducing the impact of the previous statement. Before moving on participants must fill-in the missing letters of a key word crucial to the intended interpretation of the sentence. This procedure helps ensure the participant reads the sentence and understands the meaning (e.g. "*You and a friend are having a personal discussion. You tell him that you sometimes have random violent thoughts toward people you care about – thoughts you don't want to have. Your friend tells you this is nor_al*"). The comparison/maintenance condition differs in that participants are not provided with a disconfirming thought and completes a word in-line with an OC-congruent interpretation (e.g. in the sentence above the word "*we_rd*" is used instead of "*nor_al*"). Applying this "sentence paradigm" across five experiments, Mathews and Mackintosh (2000) confirmed the experimental procedures were successful in producing each condition's intended pattern of interpretation. This procedure has displayed efficacy in inducing the desired interpretation bias, which

then generalizes to new ambiguous scenarios (Mathews & Mackintosh, 2000), with lasting post-training change (Yiend, Mackintosh, & Mathews, 2005). CBM procedures have been shown to lead to lower distress and impairment (Mathews & Mackintosh, 2000), are well accepted by patients, and have displayed low reports of dropout (Clerkin & Teachman, 2011). Also of note, instigating a decrease in negative interpretive bias has been shown to diminish state anxiety reactions to later stressors (Wilson, MacLeod, Mathews, & Rutherford, 2006). These findings are very encouraging that the use of CBM approaches to manipulate the information-processing biases important in anxiety and depression might have therapeutic benefits in the treatment of these disorders.

CBM has demonstrated efficacy in impacting various clinically relevant symptoms in depression (Lang, Moulds, Holmes, 2009; Williams et al., 2013), GAD (Amir, Beard, Burns, & Bomyea, 2009) and social anxiety disorder (Rapee et al., 2013). Importantly, following CBM training findings display reliable reductions in emotional reactivity to subsequent stressor tasks, such as the sentence completion paradigm task (Clerkin & Teachman, 2011; Holmes, Lang, & Shah, 2009). These results suggest that changes in symptoms and reactivity to stressor tasks may reflect the development of new trained associations

When the focus of CBM is training healthier *interpretations*, it is referred to as CBM-I. Recent meta-analysis on the effectiveness of CBM-I to impact cognitive biases, anxiety, and depression found that it displayed a large effect size of (g = 0.81), and these findings were not attenuated by the clinical characteristics of the sample, the number of training sessions, or type of control condition (Hallion & Ruscio, 2011). This suggests that although CBM does not appear to match effect sizes of most empirically supported interventions (ESI), it does show promise as a possible complementary intervention administered in conjunction with traditional psychotherapy (Hallion & Ruscio, 2011; Willaims & Grisham, 2013). Accordingly, CBM may prove to be a fruitful therapeutic technique in addition to current ESIs, but also when these ESIs are rejected, fail, or unavailable (e.g. unavailable geographically, too costly).

Tying CBM-I within the cognitive theory of emotional disorders and their treatment, there is support that CBM-I may work through the process of cognitive restructuring, and specifically, *threat reappraisal*. Threat appraisal is a tendency to overestimate the likelihood of harm (i.e., likelihood bias) and/or the negative consequences of anticipated harm (i.e., Clark & Beck, 2010). These inflated threat assessments produce avoidance, which is thought to interfere with the process of effectively reappraising threat, thereby creating a vicious cycle (Beck et al., 1985; Clark & Beck, 2010). The CBM-I procedure ensures that an interpretation bias is triggered by the ambiguous scenarios, and participants are then forced to solve the key word in accordance with a healthy response to scenario (Grey & Mathews, 2000). The observed effects of CBM-I may stem from active generation of benign or positive meanings in response to ambiguous situations, where threats were previously interpreted (Beadel et al., 2014).

In OCD, cognitive-behavioral models suggest that it is not the content of intrusive thoughts, but their interpretation as personally meaningful and significant that is more strongly associated with the repetitiveness of thoughts, behaviors, and distress characterizing the disorder (Frost & Steketee, 2002; OCCWG, 2005; Rachman, 1997, 1998; Salkovskis, 1985). Cognitive interventions are frequently constructed upon the idea that shifting OC interpretations and beliefs to healthier ones will lead to symptom reductions (e.g., Whilhelm et al., 2009). Research suggests that it is possible to manipulate OC-relevant interpretations and beliefs (e.g. Clerkin & Teachman, 2011; Forrester, Wilson, & Salkovskis, 2002; Rassin, Merckelbach, et al., 1999; Teachman, Woody, & Magee, 2006; Zucker, Craske, Barrios, & Holgium, 2002), and there is a growing literature displaying the effectiveness of utilizing CBM-I for OC symptoms (Williams & Grisham, 2014). Utilizing CBM-I with non-clinical participants high in OC symptoms has been found to enable the individuals to attribute less significance to intrusive thoughts, adopt healthier interpretations, as well as experience less distress and urge to neutralize compared to those in the control condition (Clerkin & Teachman, 2011; Williams & Grisham, 2013). Moreover, when compared to a control condition that solved scenarios 50 percent in a positive/healthy interpretation and 50 percent consistent with negative OC relevant interpretations, there was some evidence that individuals in a "positive" training condition had more adaptive responses to an OC stressor task (i.e., they reported

less urges to perform neutralizing activities). Targeting interpretations related to a specific cognitive bias such as TAF, may be very beneficial in developing treatments tailored to specific symptom profiles (Clerkin et al., 2014).

CBM-I for TAF Biases

In a previous study, we sought to test the feasibility of a brief computerized CBM-I as an intervention to reduce TAF bias among undergraduates who reported the presence of obsessional intrusions (Siwiec, Davine, Kresser, Rohde, & Lee, 2017). We examined if the TAF-focused CBM-I could decrease participants' emotional reactions towards a variety of obsessional thoughts, including personally-relevant intrusions. We compared participants in an active CBM-I (providing a healthier/benign interpretation as opposed to a TAF-ridden interpretation to an intrusive thought) against a control CBM-I (which did not challenge TAF interpretations). Results indicated that participants in the active condition displayed a significantly greater reduction in the severity of total TAF, TAF-M, and emotional reaction to personally-relevant obsessional intrusions than the control condition. Reductions on either TAF-LS or TAF-LO did not differ by condition. This study presented encouraging data supporting the feasibility of CBM-I to be developed as an effective intervention for TAF, but there were some limitations. For example, we could not rule out the possible influence of demand characteristics, as it may have been apparent to participants if their training condition was designed to be helpful or not. We were also unable to control for participants who may have rushed through procedures without fully reading the training scenario. Additionally, outcome analyses were based solely on self-report measures. It would have been helpful to have included a behavioral stress reaction task and physiological outcome measure to gauge possible change is stress reaction between conditions. Finally, we did not assess changes in the use of neutralization behaviors (e.g. thought suppression, rituals, avoidance), or urges to carry out these behaviors. There is without question room to improve study procedures and methods to address these limitations in future research.

In sum, along with the emerging findings in the potential efficacy for CBM-I for TAF (Siwiec et al., 2017) and OCD (Clerkin and Teachman, 2011; Williams & Grisham, 2013), there is growing

evidence for CBM-I procedures to improve interpretation bias in different pathologies (Amir et al., 2009; Lang et al., 2009; Rapee et al., 2013; Williams et al, 2013; Yiend et al., 2014), with these changes reliably accompanied by decreases in both distress and impairment (Mathews & Mackintosh, 2000; MacLeod, 2012), as well as high acceptability with the CBM-I procedures by participants (Clerkin & Teachman, 2011). Yet, a potential problem with past CBM-I studies is the use of a comparison condition which also incorporated a CBM-I structure, therefore leaving the possibility for training effects to influence both the active and control conditions. For this reason, before any further assertions can be made to the effectiveness of CBM-I for TAF and other pathologies, it is important to compare the active training condition against a TAF control condition (designed to not challenge TAF bias), as well as a credible psychological comparison condition. Ensuring that all three conditions are similar in length and structure, would support that any differences between training conditions was due to the content of the trainings, not the structure, or act of completing the trainings.

Psychophysiological Response to a Stressor

Research has supported that individuals differ in how they respond to psychological stressors and that these differences are relatively stable across time. Findings indicate that individuals with anxiety disorders are characterized by a rigid emotional response styles, such as an inability to inhibit inappropriate anxious responses in non-threatening situations (Berntson & Cacioppo, 2003). Findings also demonstrated that compared to non-anxious controls, individuals with anxiety disorders evidence diminished high frequency heart rate variability (HF-HRV) at rest or in response to anxiety stressors (Klein et al., 1995; Friedman & Thayer, 1998a, 1998b). HRV in the high frequency spectrum (HF-HRV) represents an index of respiratory sinus arrhythmia (RSA), which involves regular patterns of heart rate (HR) fluctuations that are linked to the breathing cycle and influenced by the parasympathetic nervous system (Pittig et al., 2013; Thayer and Lane, 2000). Specifically, from electrocardiogram (ECG) recordings HRV is calculated from the collection of inter-beat intervals (i.e. time between heart beats), which are the temporal distance between R-spikes, and correspond with the contraction of the heart's ventricles (Appelhans & Luecken, 2006). HF-HRV is usually recorded from a range between 0.15 Hz to

0.4 Hz (Appelhans & Luecken, 2006). Theories have proposed close links between low RSA and psychopathology, especially anxiety disorders. The Polyvagal theory (e.g., Porges, 2007) links autonomic regulation and RSA to a variety of psychopathological states and behaviors. Adaptive behavior and autonomic responses emerge from the hierarchical organization of different phylogenetic subsystems of the autonomic nervous system with phylogenetically newer systems inhibiting older ones. These inhibition processes are essential for adaptive behavior with (autonomic) variability being associated with healthy responses. Deficits in these inhibitory processes are seen as a risk for emotion dysregulation and psychopathology more generally (Beauchaine, 2001). The associated neurovisceral model of cardiac and emotion regulation proposes specific links between cardiovascular variability and anxiety disorders (Friedman, 2007; Thayer & Lane, 2000). Diminished heart rate variability (HRV) in anxiety disorders is thought to reflect a reduction in vagal control (ESC/NASPE Task Force 1996; Berntson *et al.* 1997) and an associated loss of autonomic 'flexibility' (Friedman & Thayer 1998; Monk *et al.* 2001).

To date, the two studies which measured HF-HRV with OCD have displayed mixed findings, as one study found no significant differences between OCD patients and controls (Slaap et al., 2004), while another found a difference but could not rule out the likely influence of psychotropic medications in their sample (Pittig, Arch, Lam, & Craske, 2013). In contrast, a recent meta-analysis by Bandelow and colleagues (2017) has found the time domain measures of HRV to be much more consistent predictors of panic disorder, post-traumatic stress disorder, and GAD. HRV by Time analyses findings with GAD is of relevance, as GAD has consistently been shown strong associations with TAF (Muris et al., 2001; Thompson-Hollands et al., 2013). There are two commonly-used categories of time domain measures of HRV. The first is calculated by detecting beat to beat intervals over time, includes standard deviation of normal sinus intervals (SDNN), and the average of these SDs (SDANN) which represents the standard deviation of "NN" intervals (Sztajel, 2004). The second category are calculated from differences between adjacent beat intervals, the most frequently used being root mean square of successive differences (RMSSD) and pNN50 (the percent of normal sinus intervals (NN) exceeding 50 ms apart (Stein et al.,

1994) RMSSD and pNN50 are highly correlated with frequency domain derived HF oscillation (Stein et al., 1994). The study chose to proceed with an HRV by Time domain analysis, but choose not to include SDNN or SDANN as they are thought to reflect day/night changes in HRV and are sensitive to change in posture, circadian rhythm, and physical activity (Sztajel, 2004), and therefore not practical for the current study's brief recording duration. The study did incorporate some of the more common HR indices (mean HR and mean RR), as well as two indices considered to represent parasympathetically mediated HRV (RMSSD and pNN50) (Stein, Bosner, Kleiger, & Conger, 1994). Higher scores on RMSSD and pNN50 indicate greater HRV, which reflects more flexible and resilient regulation of emotional stressors (Chalmers, Quintana, Abbot, & Kemp, 2014).

The measurement of psychophysiological response to an experimental stressor in OCD is becoming more common (Beadel et al., 2014; Duncko & Veale, 2016; Jones & Bhattacharya, 2014), but existing studies have been very preliminary. Within CBM-I and OC specifically, emotion regulation in response to a stressor (sentence completion paradigm) has either been recorded as changes in negative affect (Clerkin et al., 2011; Williams & Grisham, 2013), or resting HR for 1 minute prior to the stress task (no measurements during or following the stressor). It is important for research to more accurately measure any changes to emotional reactivity (including physiological arousal) with more frequent (before, during, and after the stressor task) and longer durations of measurement. This will help examine the strength of connections between cognitive bias change, symptom change, and physiological arousal. The new study incorporated a TAF stressor task, while simultaneously measuring psychophysiology (ECG and HR) at pre-training, post-training, and at 1-month follow-up. The stressor task is the sentence completion paradigm and has been used in this capacity during previous studies (Beadel et al., 2014; Clerkin & Teachman, 2011; Clerkin et al., 2014).

Purpose of the Study

The study was the next logical step in developing a targeted intervention aimed at modifying interpretations of obsessional thoughts linked to TAF. Based on previous findings (Siwiec et al., 2017) CBM-I for TAF was expected to decrease TAF bias, as well as potentially lowering the severity of

intrusive thoughts and accompanying symptoms. The current study compared active TAF against both a control TAF condition, as well as a credible comparison condition, called stress management psychoeducation (SMP). In individuals with higher reported obsessions, increases in obsessional severity coincides with increased stress and negative affect. SMP was intended to indirectly reduce the severity of obsessions by reducing stress, through providing education about the causes of stress, its effects, and stress reduction techniques (i.e. increasing problem solving abilities, time management and organization, relaxation, interpersonal problem solving, and assertiveness; Woody et al., 2010). SMP is a standard part of empirically supported treatments of anxiety disorders (Zimbarg, Craske, & Barlow, 2006), and has been shown to be effective in reducing obsessions which are mild-to-moderate in frequency (Whittal et al., 2010; Woody, Whittal, & McLean, 2011). Important to our study, the SMP condition is a credible comparison condition as it is thought to facilitate reductions in measures of stress (and obsessions as well), but it does not target TAF. The SMP condition was constructed to match the other two conditions in the structure and length of training. There are several reasons to test the efficacy of an active TAF focused CBM-I against a credible psychological comparison condition. Firstly, for TAF training to be a clinically useful intervention, it should show its therapeutic effect to be greater than that of the primary but TAF-irrelevant component of general talk therapy (i.e., stress management). Otherwise, the clinical usefulness of TAF training is not demonstrated. Secondly, adding a credible psychological comparison condition, which is similar to a general talk therapy, helped demonstrate if TAF training could produce therapeutic effects in TAF reduction as compared with non-specific training's effects (such as expectancy, demand characteristic). Unfortunately, in the previous study (Siwiec et al., 2017) we could not tell whether the effects of TAF training was due to the changes in TAF itself or just other non-specific factors. Thus, having another positively-toned, more credible therapeutic "placebo" intervention provided useful information as to whether the attempt at direct modification of TAF in the active training produced effects that are greater than those achieved by this non-specific training condition.

The Current Study

The Objective and Hypotheses of the Current Study

The study recruited UWM undergraduates (n = 57) who display at least minimal levels of TAF bias and obsessing symptoms and randomized them to either the active, control, or SMP training conditions. The active condition was a TAF Incongruent (TAF-INC) training, designed to decrease TAF linked to obsessional thoughts by modifying them with healthier interpretations. The control condition was a TAF Congruent (TAF-CON) training, designed to sustain TAF-like interpretation of obsessional thoughts by not challenging them. The credible psychological comparison condition was SMP and was designed to provide psychoeducation about stress, its causes, and common stress management techniques. As the SMP condition did not challenge TAF, we expected that participants would not display significant reductions in measures of this cognitive bias. In contrast, we did expect that SMP participants received benefit from the condition in the form of general reductions in stress, which was assessed with associated study measures. We sought to test the following hypotheses:

Aim 1. To determine whether TAF-INC would show superior training outcomes in reducing TAF biases, relative to TAF-CON and SMP.

Hypothesis 1a. At post-training TAF-INC would display significantly lower TAF scores than the other two conditions, whereas there would not be a significant difference in TAF between the TAF-CON or SMP conditions. This was determined by comparing the three conditions in post-training levels on (i) TAF total scores, (ii) TAF-M scores, (iii) TAF-LO scores, (iv) TAF-LS scores, (v) POETS-M scores, and (vi) and POETS-L scores.

To examine the long-term training effects of TAF-INC in reducing TAF.

Hypothesis 1b. At 1-month follow-up assessment, TAF-INC would display significantly lower TAF biases (TAFS scores and POETS scores) than TAF-CON and SMP, while the two later conditions would not significantly differ from each other.

Aim 2. To determine whether TAF-INC would show superior training outcomes, relative to TAF-CON and SMP, in reducing emotional distress to obsessions.

Hypothesis 2a. At post-training, TAF-INC would display significantly lower emotional distress to obsessions than the other two conditions (Top-10 ROII-Distress and POETS-GE scores). We also hypothesized that the SMP condition would display lower emotional distress than TAF-CON.

To determine the long-term training effects of TAF-INC in reducing emotional distress to obsessions

Hypothesis 2b. At 1-month follow-up assessment, TAF-INC would show a significantly lower level of distress (ROII-Distress and POETS-GE) than TAF-CON and SMP, while the SMP condition would display lower scores than TAF-CON.

Aim 3. Examine the effects of TAF-INC using emotional and physiological outcomes in a TAF-provocation stress challenge behavioral procedure.

Hypothesis 3a. At post-training, we hypothesized the TAF-INC would display significantly reduced psychophysiological reactivity to a TAF stressor task than the SMP condition, which would display reduced responses than TAF-CON. This was determined by comparing the three conditions at follow-up in (1) subjective emotional reactivity (SUDs ratings), (2) overall mean HR, and (3) time domain analyses of HRV (RMSSD and pNN50).

To determine the long-term training effects of TAF-INC in reducing psychophysiological reactivity to a TAF stress provocation

Hypothesis 3b. At follow-up, we hypothesized the TAF-INC would display significantly reduced emotional reactivity to a TAF stressor task than the SMP condition, which would display reduced scores than TAF-CON. This was determined by comparing the three conditions at follow-up in (1) subjective emotional reactivity (SUDs ratings), (2) overall mean HR, and (3) time domain analyses of HRV (RMSSD and pNN50).

Method

Eligibility and Recruitment

UWM undergraduates who were at least 18 years old who (i) score of at least 1 [*A Little (Distressed or Bothered*)] on the OCI-R obsessing subscale, and (ii) at least one TAFS item scored 3

(*Agree*) or 4 (*Agree Strongly*) were be eligible to participate in the study. A score of 1 or higher on the obsessing subscale of the OCI-R indicates the presence of obsessional intrusions, and was used as a cutoff in previous research (Siwiec et al., 2017). A score of 3 or above on an item of the TAFS indicates the participant agreed with and held some pronounced TAF bias.

Measures

Self-Report Measures

The *Thought-Action-Fusion Scale* (*TAFS*; Shafran et al., 1996) is a 19-item measure which assesses the degree to which importance and responsibility is lent to a variety of intrusive and distressing thoughts containing moral and likelihood themes. The measure uses a 5-point scale ranging from 0 (*Disagree Strongly*), to 4 (*Agree Strongly*). There are no cutoff scores but higher TAFS scores are indicative of higher rates of TAF cognitions (Shafran et al., 1996). In student and community samples the three-scale model (TAF-M, TAF-LS, TAF-LO) has displayed moderate to strong association between the scales (r=.*25* - .69; Abramowitz et al., 2003; Bailey et al., 2014; Coles, Mennin, & Heimberg, 2001; Rassin, Merkelbach et al., 2001). The TAFS was used as a primary outcome measure.

The *Obsessive-Compulsive Inventory Revised* (*OCI-R*; Foa et al., 2002) is an 18-item measure of OCD symptoms in the past months, using a 5-point scale from 0 (*Not at all*) to 4 (*Extremely*). The measure assesses six types of symptoms: (1) Washing, (2) Checking, (3) Obsessing, (4) Mental Neutralizing, (5) Ordering, and (6) Hoarding. The OCI-R was administered to assess the severity of obsessing, as well as the overall severity of OC symptoms. A total score of 21 or above indicates the likely presence of clinical levels of OCD symptoms.

The *Yale-Brown Obsessive-Compulsive Scale Checklist* (*Y-BOCS* Checklist; Goodman et al., 1989) is a 57-item measure which identifies *current* and *past* obsession and compulsions. The obsession checklist of the Y-BOCS includes various domains of mental intrusions and served to identify the primary obsession for each participant (i.e., the most distressing obsession chosen by the participant) used during the POETS.

The *Primary Obsession Evaluation of TAF Scale* (*POETS*; Siwiec et al., 2017) is a scale designed to assess the participant's TAF emotional and cognitive reactions toward a specific (primary) obsessional intrusion. In using the POETS, a study clinician helps the participant identify their primary obsessive thought using the participant's Y-BOCS Obsession Checklist as a guide and asking about any "current" endorsed obsessions. The scale uses a 7-point scale from 0 (*Not Distressing at All*), to 6 (*Extremely Distressing*). The scale uses the main obsessional thought and then asks questions in 3 domains (5 questions each): (1) General Emotional Reactions, (2) Moral TAF, and (3) Likelihood TAF. The 3 domains were created in relevance to the TAF construct, as the general emotional reaction domain gauges discomfort with the presence of the thought, the moral domain gauges the moral implications of the thought to the individual (moral TAF), and the likelihood domain gauges the belief to which having the thought will cause it to occur (likelihood TAF).

The *Revised Obsessional Intrusions Inventory - Distress* (*ROII-Distress*) is a 52-item self-report measure, modified (Siwiec et al., 2017) from the original ROII (Purdon & Clark, 1993, 1994) to assess how distressing various intrusive thoughts, images, and impulses *would be* to the participant in the event of their intrusion. The measure uses a 7-point scale from 0 (*Not Distressing*) to 6 (*Extremely Distressing*). Unlike the original ROII, the ROII-Distress does not use a time frame as the obsessive thoughts, images, or impulses may not have occurred yet, but asks instead of distress *if* the thought were to occur. In consideration of heterogeneity in obsessional intrusions across individuals, we computed an idiographic distress index, consisting of the 10-highest endorsed ROII-Distress items for each participant at pre-training. The measure was used at pre-training, after trainings, and at the follow-up assessments.

Clinician Administered Measures

TAF Stressor Task

During the study, participants completed a stress-challenge task while gauging their psychophysiological reactions (i.e. resting, peak, and variability in HR) to a TAF-sentence completion task. This task followed the same procedures commonly used in CBM research (Berman et al., 2011; Clerkin et al., 2011; Rachman, Shafran, Mitchell, Trant, & Teachman, 1996), where participants are asked

to think of a loved one, then for three minutes alternate between writing out the sentence, *I hope (name of loved one) is in a car accident*, followed by thinking about this scenario for 10 seconds. The study stressor task incorporated all the standard procedures but extended the time from three to five minutes to better allow for psychophysiological measurement. Psychophysiological data in the form of HR (resting, peak, and variability) was measured for 5-minute durations, at baseline reading, during the stressor task, as well as a five-minute recovery phase. All steps in this stressor task were completed after pre-training measures (before randomization), following training/post-training measures, and again at the 1-month follow-up to assess changes in psychophysiological reactions by condition. Additionally, we incorporated a rating procedure incorporated from Berman et al., (2011) which includes asking the participants before the stressor task to rate their distress and anxiety using a subjective units of distress scale (SUDS), created in collaboration between the participant and study staff and ranging from 0 (*no distress*) to 100 (*most distress possible*). Immediately following the stressor task participants were asked to report both their current level of anxiety and distress, their peak levels of anxiety and distress during the phase, how morally wrong they judge their actions to be [0 (*not morally wrong*) to 100 (*extremely morally wrong*)]; how strong their urge to cancel the effects of writing the sentence to be [0 (*no urge*) to 100 (*uncontrollable urge*)]; and how likely the event is to occur following the task [0 (*no change*) to 100 (*absolute certainty*)].

Finally, consistent with past studies which incorporated a similar stressor task (Beadel et al., 2014; Clerkin et al., 2011, 2014), we recorded instances of neutralization urges and behaviors during and following the stressor task. Following completion of the stressor task, participants completed a short questionnaire that asked them to report their *urge* to engage in neutralization activities, such as ripping up the stressor task paper, throwing away the paper, writing out a new sentence, washing their hands, making a phone call, saying a prayer, or "other". Participants reported their urges to engage in these neutralization activities on a scale from 0 (*not at all*) to 8 (*totally/definitely*), computing an average score as their neutralization urge. Next, participants were asked the strength of their urge to engage in any of the neutralization *behaviors* from 0 (*not at all*) to 100 (*definitely*), and we recorded if they planned to

neutralize (*yes* or *no*). The number of activities were recorded. This information was used during data analyses to ensure that the three conditions are equivalent in neutralization urges and behaviors.

Psychophysiological Data

In the study, potential group differences in physiological reactivity to the TAF provocation (i.e., HR) were repeatedly examined before, during, and after the stressor task, to assess changes by condition. HR was selected to operationalize autonomic arousal that occurs as a result of exposure to a feared stimulus (Cuthbert et al. 2003; Lang et al. 1983). HR was recorded using a Zephyr Bioharness (Zephyr Technology Corporation, Annapolis, MD, US), a U.S. FDA-approved wireless physiological monitoring device that consists of a 50-mm wide, adjustable fabric chest strap and attached transmitter unit (total weight 85 grams). The BioHarness determined HR via capture of cardiac electrical impulses by conductive fabric (anti-microbial silver lycra) skin electrodes that are relayed to the transmitter for electronic filtration and analysis (Kim, Roberge, Powell, Shafer, & Williams, 2013). While participants are wearing this bioharness, the raw electrocardiogram (ECG) signal was recorded remotely through the USB data receiver connected to our secure lab computer. Additionally, the study included RMSSD and pNN50 as they are common time domain analyses of HRV analyses thought to represent parasympathetically mediated HRV (Task Force, 1996) and were chosen as good indices for the study. Moreover, the study recorded each participant's mean the mean HR per minute, as well as average heart beat period in milliseconds (mean RR) deriving from raw RR-intervals. The high frequency (HF) component of HRV is characterized by the range from 0.15 Hz to 0.4 Hz (Appelhans & Luecken, 2006). This Zephyr Bioharness system records raw ECG signal and calculates HR and inter-beat intervals (i.e., R-R intervals) with good accuracy. Time domain analyses of HRV was calculated using the Kubio 2.0 computation software. Measurements was recorded at baseline (i.e., 5-minute base rate of HR when the participant is not engaging in an anxiety-provoking task), during the TAF stressor task (5-minutes), during a recovery phase (5-minutes). This procedure occurred following pre-training assessment measures (before training), and again after post-training assessment measures, as well as following assessment measures at the 1-month follow-up.

Interpretation Training (TAF-INC vs TAF-CON vs SMP)

The study incorporated a computerized interpretation training version of the procedures in the "word completion task" used in past research (Beadel et al., 2014; Clerkin and Teachman, 2011, 2014; Mathews & Mackintosh, 2000; Williams & Grisham, 2013) which presented statements to the participant meant to elicit TAF.

In the active condition (TAF-INC) participants were presented with an obsessional thought meant to elicit either moral or likelihood TAF, followed by a sentence incongruent to TAF bias and meant to reduce the impact of the previous statement. Before being allowed to move on, participants had to correctly fill-in two missing letters inside a key word for the interpretation of the sentence. Example: *I was eating lunch with my best friend. All of a sudden, a thought of poking my friend's eye with my fork came into my head. Having this thought in my mind is (m_ani_gless), as everyone has these thoughts but they almost never lead to any action.* If the participant failed to fill-in and correctly spell the key word they were given an error message and told to try again. This procedure ensured that the participant reads each sentence and understands the meaning.

The maintenance condition (TAF-CON) differs in that participants were not provided with a disconfirming sentence, and instead are provided with a sentence congruent with TAF bias. Example: *I was eating lunch with my best friend. All of a sudden, a thought of poking my friend's eye with my fork came into my head. Having this thought in my mind is (unac_ept_ble). If my friend knew what I was thinking he/she would have thought I am dangerous and unpredictable.* Like the active condition, participants were only able to move on when they correctly solve the key word.

In the stress management psychoeducation (SMP) condition participants were presented with concise three to four lines of psychoeducation about stress and stress management. Each piece of psychoeducation was similar in length to the obsessional thought and interpretations presented in the TAF-INC and TAF-CON conditions trainings. This psychoeducation was drawn directly from stress management training from the related chapter in empirically supported treatment for GAD, *Master Your Anxiety and Worry* (Zinbarg, Craske & Barlow, 2006), as well as a stress management treatment for

obsessions manual developed by Woody and colleagues (2003). In each cluster there was also a key word missing two letters, which participants had to solve before moving on. Example: "*Research has shown there is a significant relationship between stress and the frequency of intrusive thoughts. Even mild stress leads to more intrusive and bothersome thoughts. It is important to become aware of the stressors evident at the time obsessions developed, to (unde_st_nd) their fluctuations over time."*

In all three training conditions participants worked on a computer through 100 randomized distressing thought scenarios or SMP psychoeducation items, depending on condition. Following each successful solving of the incomplete key word, participants were presented with a one sentence comprehension question. Example. *From the scenario, if your friend knew what you were thinking would he/she think you are unpredictable? Yes/No*. The computer program did not permit participants to continue until the comprehension question was answered correctly. Comprehension questions are a standard part of many CBM-I trainings, and help to both ensure that participants are attending to the content of the training scenarios (not rushing) and reinforce the resolution of ambiguity (Beadel et al., 2014; Clerkin et al., 2011, 2014; Menne-Lothmann et al., 2014). Following the comprehension questions, participants were presented with one sentence of encouragement and then proceeded to the next thought scenario. The trainings took place on the same day as the pre-training assessment. Using similar training procedures as Siwiec et al., (2017), the new trainings were expected to take between 45 minutes to an hour complete.

Procedures

Pre-Screening

General information about the study was found on the UW-Milwaukee online research study participation site (SONA) and those interested were directed to the study's prescreening consent form. Once the consent was signed, participants completed online versions of the OCI-R and TAFS. Participants at or above the cutoffs were contacted automatically by email and prompted to set up a pre-training assessment appointment. Participants below the cutoff scores were automatically sent an email thanking them for their interest but informing them they were not eligible.

Pre-Training Assessment

Following the informed consent procedure, participants proceeded though computerized self-report questionnaires which included a demographics questionnaire, contact information sheet (to gain primary email and phone numbers), and self-report measures. The self-report questionnaires took participants between 30 minutes to 1 hour to complete. Participants completed the POETS and YBOCS Severity Scale with a research assistant (RA). Finally, participants completed the three phases of the TAF stressor task.

Randomization

Following the stressor task, using a preset computerized randomization list, participants were randomized to either the TAF-INC, TAF-CON, or SMP conditions.

Training, Psychoeducation, and Process Measures

Following randomization participants started their appropriate training (TAF-INC, TAF-CON, or SMP). Each training session and accompanying measures took about approximately 45 minutes to complete.

After each training session participants completed measures to evaluate potential group differences in relevant variables which may have changed following training: the TAFS to assess TAF bias, the ROII-Distress Assessment Scale to assess emotional reactions, and the POETS to assess their emotional reactions to their primary obsessional thought. Participants then completed the three stages of the TAF stressor task again (including HR measurement and SUDS), to assess any group differences in psychophysiological reactions by training condition (TAF-INC, TAF-CON, SMP).

1-Month Follow-up Assessment

The follow-up Assessment were scheduled to occur approximately thirty days after the first assessment and training. The Post-Training assessment measures procedures were identical to the pre-training assessment, followed by the stressor task (including HR measurement and SUDS). Participants who completed all study procedures received a $10 Amazon gift card, as well as course credit hours.

Data Analysis

To test hypothesis 1 (i.e., the effect of TAF-INC vs. TAF-CON vs. SMP on the level of TAF), hypothesis 2 (i.e., TAF-INC vs. TAF-CON vs. SMP on distress symptoms), and hypothesis 3 (i.e. TAF-INC vs. TAF-CON vs. SMP on psychophysiological reactivity to a TAF Stressor Task), we conducted a series of ANCOVAs controlling for pre-training levels of the target outcome measure, as well as pre-training levels of emotional distress (DASS-21 Total score) and obsessional symptoms (OCI-R obsession scores). It was important to control for pre-training emotional distress and obsessional severity, as (i) these variables are significantly associated with TAF beliefs as well as the experience of mental intrusions (Rassin et al., 2000; Shafran & Rachman, 2004), and (ii) it was important to demonstrate that the CBM-I training outcomes were not merely the result of baseline differences in the severity of obsessional intrusions and emotional distress. We conducted Levene's test of Homogeneity to ensure that variances were similar for all three conditions. A significant difference between conditions (at either post-training or follow-up accordingly) would indicate group differences in the target outcome variable (e.g., TAF or obsessional severity) between the three training conditions. For outcomes which display a significant difference between conditions we conducted a post hoc Bonferroni correction test to see where condition differences occurred. The Bonferroni correction is intended to reduce Type I errors when multiple tests or comparisons are conducted, but it also causes a decrease in power for the study (Moran, 2003; Nakagawa, 2004; Verhoeven, Simonsen & McIntyre, 2005).

Results

Participants

There were 203 UWM undergraduate students who completed the online prescreen for the study, 145 were informed they were eligible to participate, and 57 completed a pre-training assessment and were randomized. Of the 57 eligible, 21 were allocated to the TAF-INC condition, 19 to the TAF-CON condition, and 17 to the SMP condition. The number of completers for TAF-INC (N = 17, 81%), TAF-CON (N = 14, 74%), and SMP (N = 13, 76%) did not differ by training condition χ^2 (2, N = 42) = .84, p =

.659. Those who dropped from the study (TAF-INC = 3, TAF-CON = 5, SMP = 4) became unresponsive to messages and discontinued with the study.

Consort Diagram

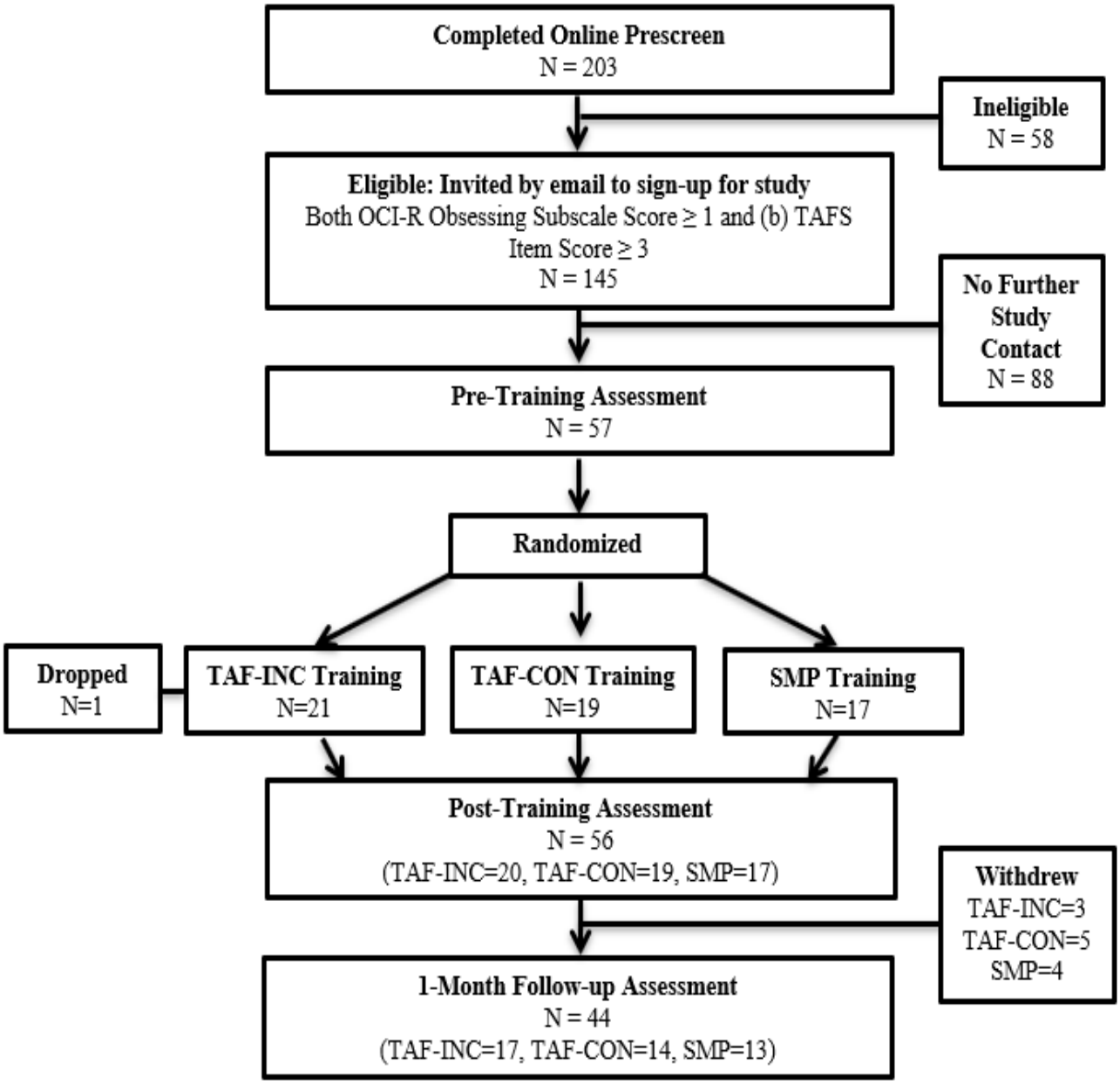

Figure 1. Consort Diagram

Comparing the demographic and baseline characteristics of all those who were randomized, the three conditions did not differ in respect to gender, age, race, ethnicity, marital status, past psychological treatment obtained, or current psychological treatment (see Table 1).

Table 1
Baseline Demographics of All Eligible Participants

	TAF-INC n = 21 (%)	TAF-CON n = 19 (%)	SMP n = 17 (%)	Chi-Square or One-Way ANOVA
Gender				$X^2 = 3.76$, $p = .153$
Male	6 (28.6)	1 (5.3)	4 (23.5)	
Female	15 (71.4)	18 (94.7)	13 (76.5)	
Age	X=22.00 (SD=6.52)	X=21.79 (SD=4.58)	X=23.88 (SD=7.84)	$F(2) = .58$, $p = .564$
Race				$X^2 = 10.21$, $p = .251$
White	16 (76.2)	14 (73.7)	10 (58.8)	
Black	1 (4.8)	3 (15.8)	1 (5.9)	
Asian	4 (19.0)	1 (5.3)	2 (11.8)	
Pacific Islander	0 (0)	0 (0)	0 (0)	
Native American	0 (0)	1 (5.3)	1 (5.9)	
Multiracial	3 (14.3)	2 (10.5)	4 (23.5)	
Hispanic/Latino	3 (14.3)	2 (10.5)	4 (23.5)	$X^2 = 1.20$, $p = .550$
Marital Status				$X^2 = .94$, $p = .625$
Not Married	18 (85.7)	16 (84.2)	16 (94.1)	
Married	3 (14.3)	3 (15.8)	1 (5.9)	
Past Psych Treatment				$X^2 = .19$, $p = .908$
Yes	11 (52.4)	11 (57.9)	10 (58.8)	
Talk Therapy/Counseling	11 (52.4)	11 (57.9)	10 (58.8)	
Drug Therapy	7 (33.3)	6 (31.6)	7 (41.2)	
Other	0 (0)	1 (5.3)	1 (5.9)	
Current Psych Treatment				$X^2 = 1,85$, $p = .397$
Yes	6 (28.6)	3 (15.8)	6 (35.3)	
Talk Therapy/Counseling	4 (19.0)	3 (15.8)	3 (17.6)	
Drug Therapy	6 (28.6)	3 (15.8)	6 (35.3)	
Other	0 (0)	0 (0)	0 (0)	

Note. % = percent.

Demographics and Pre-training Characteristics

The TAF-INC, TAF-CON, and SMP conditions did not differ in pre-training TAFS total, $F(2,54) = .05$, $p = .952$, TAFS-M, $F(2,54) = .39$, $p = .682$, TAFS-LS, $F(2,54) = 1.20$, $p = .31$, TAFS-LO, $F(2,54) = .72$, $p = .491$, POETS-M, $F(2,54) = .61$, $p = .544$, POETS- L, $F(2,54) = .55$, $p = .582$, POETS-GE, $F(2,54) = .45$, $p = .641$, ROII-Distress scores, $F(2,54) = 1.49$, $p = .244$, OCI-R Obsession $F(2,54) = .021$, $p = .979$, or DASS-21 Total $F(2,54) = .02$, $p = .981$. Also, the conditions did not differ in pre-training stressor task indices of SUDS $F(2,51) = 2.23$, $p = .118$, Overall Mean HR $F(2,24) = 1.32$, $p = .287$, RMSSD $F(2,54) = .48$, $p = .624$, pNN50 $F(2,24) = .26$, $p = .771$, Urge to Neutralize following the stressor task $F(2,39) = .91$, $p = .412$, or if they Plan to Neutralize (Yes/No) $X^2 = 5.70$, $p = .058$.

The three conditions did not differ in the number of study non-completers (TAF-INC = 4, TAF-CON = 6, SMP = 5; $X^2 = .928$, $p = .629$).

Training Data

The TAF-INC and TAF-CON conditions were similar in their average minutes to complete a training (TAF-INC mean = 35.30, TAF-CON mean = 35.89), but the SMP condition took longer (SMP mean = 44.31). The difference between conditions was significant ($p = .005$).

Table 2

Study Measures Mean and Standard Deviation (SD) Scores

	TAF-INC						TAF-CON						SMP					
	Pre-training (n = 21)		Post-training (n = 20)		Follow-up (n = 17)		Pre-training (n = 19)		Post-training (n = 19)		Follow-up (n = 14)		Pre-training (n = 17)		Post-training (n = 17)		Follow-up (n = 13)	
Measures	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TAFS Total	40.76	12.44	21.40	16.41	26.65	14.43	39.68	13.69	38.74	10.36	35.00	12.19	39.59	12.92	34.35	16.90	35.75	15.70
TAFS-M	28.29	9.67	16.10	12.57	18.41	10.52	29.32	10.39	28.05	9.35	28.46	9.40	26.41	9.99	22.47	11.59	25.08	11.27
TAFS-LS	5.57	3.19	2.35	2.08	3.94	2.59	5.11	3.91	5.05	3.88	3.15	2.58	6.82	3.07	6.12	3.37	5.67	3.52
TAFS-LO	6.90	4.55	2.95	2.91	4.29	3.60	5.26	5.18	5.63	4.98	3.38	3.50	6.35	2.89	5.76	4.09	5.00	3.74
Top-10 ROII Distress	43.10	16.53	41.10	19.88	40.47	15.48	33.95	20.18	52.42	20.14	38.57	18.90	42.29	18.64	45.29	21.60	31.85	23.78
POETS-GE	19.90	7.93	16.60	8.54	18.44	9.80	21.84	7.80	21.00	8.85	19.15	7.66	22.12	8.30	15.94	8.23	16.33	7.94
POETS-M	11.00	7.37	8.15	3.62	10.81	9.35	12.68	7.58	15.05	9.48	10.77	7.24	13.94	9.75	12.35	9.61	9.00	7.32
POETS-L	16.81	8.14	11.15	7.62	16.00	8.86	17.32	6.59	17.16	7.93	14.23	6.72	19.29	7.83	14.06	7.00	12.50	5.93
OCIR Total	25.14	13.08			17.71	11.98	21.95	13.86			12.08	8.96	22.29	10.66			15.75	7.56
OCIR Obsess	4.38	2.73			3.18	3.17	4.47	2.72			2.15	1.99	4.29	2.44			2.25	0.97
DASS-21 Total	80.95	24.38			66.47	20.33	80.74	25.31			71.69	17.39	82.35	29.75			62.33	18.74
SUDS	34.25	28.02	16.11	20.40	19.64	25.90	53.33	28.95	41.00	25.93	27.78	28.07	44.44	26.34	24.81	25.77	32.73	29.36
Mean Anxiety	42.50	28.03	22.33	22.67	24.29	22.09	58.50	23.25	49.33	23.29	33.89	25.34	47.81	23.94	36.88	23.30	35.00	24.19
Peak Anxiety	56.85	29.23	31.94	26.24	34.79	27.26	73.44	21.27	60.00	22.12	45.56	29.52	60.00	25.03	42.06	23.22	44.73	32.15
Likelihood	18.50	22.25	6.67	7.67	10.43	13.88	29.72	26.70	22.47	22.44	8.89	10.24	26.00	21.92	22.31	21.27	17.27	23.17
Guilt	55.60	39.09	25.56	29.80	22.07	29.39	78.61	26.61	59.00	30.07	32.78	37.84	52.50	34.74	36.88	27.62	43.18	30.84
Urge to Neutralize	74.12	27.40	47.33	34.89	54.07	33.50	84.23	18.91	64.58	38.34	48.33	37.91	70.42	32.92	55.50	36.76	51.36	40.93
Mean RR (ms)	753.07	122.54	855.58	189.18	698.19	90.74	663.54	62.64	725.82	71.68	692.99	50.10	725.84	83.31	800.22	98.46	713.38	99.93
Mean Overall HR	82.80	12.18	78.64	13.84	89.10	13.32	93.22	7.74	87.72	11.70	89.60	9.50	87.61	14.04	83.82	16.69	85.97	11.01
RMSSD	84.11	66.81	169.80	81.82	78.87	64.33	66.92	49.41	119.94	116.26	70.20	44.81	109.12	63.88	141.75	189.59	57.38	47.55
NN50	96.29	99.65	142.75	63.07	72.89	89.24	78.50	66.64	111.75	89.20	80.50	46.59	142.33	74.65	101.60	89.93	40.75	50.60
pNN50	25.05	23.34	43.03	21.97	16.83	19.91	20.99	21.16	31.15	23.03	25.00	19.32	38.90	24.20	31.44	31.45	10.84	12.26

Note. TAF-INC=TAF Incongruent training condition, TAF-CON=TAF Congruent training condition, SMP=Stress Management Psychoeducation training condition, TAFS=Thought Action Fusion Scale, TAFS-M=TAFS Moral Subscale, TAFS-LS=TAFS Likelihood-Self Subscale, TAFS-LO=TAFS Likelihood Other Subscale, POETS=Primary Obsession Evaluation of TAF Scale, POETS-GE=General Emotional Reaction Domain, POETS-M=POETS Moral Domain, POETS-L=POETS Likelihood Domain, OCIR=Obsessive Compulsive Inventory Revised, OCIR Obsess=OCIR Obsession Subscale.

Table 3
Pearson Correlations of Baseline Measures

	TAF Total	TAF M	TAF-LS	TAF-LO	Top-10 ROII Distress	POETS GE	POETS M	POETS L	OCIR Total	OCI-R Obsession
TAF Total	1.00									
TAF-M	**.82****									
TAF -LS	**.57****	.05								
TAF-LO	**.63****	.10	**.77****							
Top-10 ROII Distress	.17	.11	.12	.15						
POETS-GE	**.31***	**.30***	.14	.11	.16					
POETS-M	**.37***	**.31***	.19	.21	**.39****	**.72****				
POETS-L	**.49****	**.35****	**.35****	**.37****	**.28***	**.58****	**.53****			
OCIR Total	**.42****	**.27***	**.30***	**.37****	**.39****	**.30***	**.38****	**.33***		
OCI-R Obsession	**.48****	**.47***	.19	.20	**.29***	**.50****	**.57****	**.41****	**.68****	
DASS-21 Total	**.31***	**.33***	.10	.08	**.44****	**.31***	**.33***	**.42****	**.56****	**.54****

Note. TAF-INC=TAF Incongruent training condition, TAF-CON=TAF Congruent training condition, SMP=Stress Management Psychoeducation training condition, TAFS=Thought Action Fusion Scale, TAFS-M=TAFS Moral Subscale, TAFS-LS=TAFS Likelihood-Self Subscale, TAFS-LO=TAFS Likelihood Other Subscale, POETS=Primary Obsession Evaluation of TAF Scale, POETS-GE=General Emotional Reaction Domain, POETS-M=POETS Moral Domain, POETS-L=POETS Likelihood Domain, OCIR=Obsessive Compulsive Inventory Revised, OCIR Obsess=OCIR Obsession Subscale.
*. Correlation is significant at the 0.05 (2-tailed)
**. Correlation is significant at the 0.01 level (2-tailed)

Group differences in TAF at post-training

To test hypothesis 1a, that TAF-INC would display significantly lower TAF scores at post-training, we conducted a series of ANCOVAs on TAFS total scores and its subscales (moral, likelihood-self, likelihood-other), including all training conditions (TAF-INC vs. TAF-CON vs. SMP) controlling for pre-training levels of the target outcome measure. Levene's test and normality checks were carried out and the assumptions were met for all the following analyses. For TAFS total scores, there was a significant difference in mean TAFS total scores at post-training ($F(2,50) = 16.11$, $p = <.001$, $\eta^2 = .27$).

Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than TAF-CON (p = <.001) and SMP (p = .001), while no significant difference was found between TAF-CON and SMP (p = .645). From the adjusted pre-training level (mean = 39.95), comparing the estimated marginal means showed that TAF-INC displayed the lowest post-training scores (mean = 20.99, 47% decrease), compared to SMP (mean = 34.62, 13% decrease), or TAF-CON (mean = 38.94, 3% decrease) (see Figure 2).

In analyzing TAFS Moral subscale scores there was a significant difference between conditions at post-training (F(2,50) = 12.37, p = <.001, η^2 = .19). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than TAF-CON (p = <.001), or SMP (p = .005), while no difference was found between TAF-CON and SMP (p = .570). From the adjusted pre-training level (mean = 28.05), comparing the estimated marginal means showed that TAF-INC displayed the lowest post-training scores (mean = 15.97, 43% decrease), compared to SMP (mean = 23.81, 15% decrease), or TAF-CON (mean = 27.00, 4% decrease) (see Figure 3).

In looking at the TAFS Likelihood-Self subscale there was a significant difference conditions in scores at post-training (F(2,50) = 11.73, p = <.001, η^2 = .17). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than TAF-CON (p = <.001), or SMP (p = .001), while no difference was found between TAF-CON and SMP (p = 1.000). From the adjusted pre-training level (mean = 5.73), comparing the estimated marginal means showed that TAF-INC displayed the lowest post-training scores (mean = 2.57, 55% decrease), compared to SMP (mean = 5.34, 7% decrease), or TAF-CON (mean = 5.51, 4% decrease) (see Figure 4).

For the TAFS Likelihood-Other subscale there was a significant difference between conditions at post-training (F(2,50) = 10.42, p = <.001, η^2 = .16). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than TAF-CON (p = <.001), or SMP (p = .003), while no difference was found between TAF-CON and SMP (p = 1.000). From the adjusted pre-training level (mean = 6.16), comparing the estimated marginal means showed that TAF-INC displayed the lowest post-training scores (mean = 2.46, 60% decrease), compared to SMP (mean = 5.61, 9% decrease), or TAF-CON (mean = 6.28, 2% increase) (see Figure 5).

For the POETS-Moral subscale there was a significant difference between conditions at post-training ($F(2,50) = 5.14$, $p = .009$, $\eta^2 = .10$). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than TAF-CON ($p = .008$), but there was no significant difference between TAF-INC and SMP ($p = .908$), or between TAF-CON and SMP ($p = .115$). From the adjusted pre-training level (mean = 12.21), comparing the estimated marginal means showed that TAF-INC displayed the lowest post-training scores (mean = 9.44, 22% decrease), compared to SMP (mean = 11.25, 8% decrease), or TAF-CON (mean = 14.68, 2% increase) (see Figure 6).

For the POETS-Likelihood subscale there was a significant difference in mean scores at post-training ($F(2,50) = 4.59$, $p = .015$, $\eta^2 = .10$). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than TAF-CON ($p = .017$), but there was no difference between TAF-INC and SMP ($p = 1.000$), or between TAF-CON and SMP ($p = .096$). From the adjusted pre-training level (mean = 17.61), comparing the estimated marginal means showed that TAF-INC displayed the lowest post-training scores (mean = 11.96, 32% decrease), compared to SMP (mean = 13.01, 26% decrease), or TAF-CON (mean = 17.25, 2% decrease) (see Figure 7).

From pre-to-post training our hypotheses were supported as the TAF-INC condition displayed significantly greater reductions in measures of TAF biases (TAF total, TAF-M, TAF-LO, TAF-LS) and in moral and likelihood TAF beliefs about their primary obsessions (POETS-M, and POETS-L). Post hoc analyses displayed this condition difference was most often displayed between TAF-INC and TAF-CON, with significant differences between TAF-INC and SMP in most analyses except POETS-M and POETS-L. Post hoc analyses also displayed that the SMP condition was not significantly different than the TAF-CON condition in any analyses.

Group differences in TAF at Follow-up

To test hypothesis 1b., that TAF-INC would show significantly lower TAF biases (TAFS scores and POETS scores) at follow-up, we conducted a series of series of ANCOVAs on TAFS total scores and subscales (moral, likelihood-self, likelihood-other), for all training conditions (TAF-INC vs. TAF-CON vs. SMP), controlling for pre-training levels of the target outcome measure. Levene's test and normality

checks were carried out and the assumptions were met for all the following analyses. For TAFS total scores, there was a significant difference in mean TAFS total scores at follow-up ($F(2,36) = 6.75$, $p = .003$, $\eta^2 = .18$). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than SMP ($p = .006$) and TAF-CON ($p = .024$), while no difference was found between TAF-CON and SMP ($p = 1.000$). From the adjusted pre-training level (mean = 39.50), comparing the estimated marginal means showed that TAF-INC displayed the lowest scores at follow-up (mean = 24.70, 37% decrease), compared to TAF-CON (mean = 35.38, 10% decrease), or SMP (mean = 38.10, 4% decrease) (see Figure 8).

The TAFS Moral subscale displayed a significant difference in mean scores at follow-up ($F(2,36) = 8.14$, $p = .001$, $\eta^2 = .17$). Post hoc tests (Bonferroni) showed that TAF-INC scored significantly lower than SMP ($p = .002$), or TAF-CON ($p = .013$), while no difference was found between TAF-CON and SMP ($p = 1.000$). From the adjusted pre-training level (mean = 28.21), comparing the estimated marginal means showed that TAF-INC displayed the lowest scores at follow-up (mean = 18.34, 35% decrease), compared to TAF-CON (mean = 26.00, 8% decrease), or SMP (mean = 27.85, 1% decrease) (see Figure 9).

In looking at the TAFS Likelihood-Self subscale there was not a significant difference between conditions at follow-up ($F(2,36) = 2.27$, $p = .118$, $\eta^2 = .07$). From the adjusted pre-training level (mean = 5.33), comparing the estimated marginal means showed that TAF-INC displayed the lowest follow-up scores (mean = 3.45, 35% decrease), compared to TAF-CON (mean = 4.07, 24% decrease), or SMP (mean = 5.36, 1% increase) (see Figure 10).

For the TAFS Likelihood-Other subscale there was not a significant difference between the conditions at follow-up ($F(2,36) = 2.03$, $p = .146$, $\eta^2 = .06$). From the adjusted pre-training level (mean = 5.95) comparing the estimated marginal means showed that TAF-INC displayed the lowest scores at follow-up (mean = 3.16, 47% decrease), compared to TAF-CON (mean = 4.77, 20% decrease), or SMP (mean = 5.11, 14% decrease) (see Figure 11).

For the POETS-Moral subscale there was not a significant difference between the conditions at follow-up ($F(2,35) = .18$, $p = .835$, $\eta^2 = .01$). From the adjusted pre-training level (mean = 12.29),

comparing the estimated marginal means showed that SMP displayed the lowest scores at follow-up (mean = 9.44, 23% decrease), compared to TAF-INC (mean = 10.44, 15% decrease), or TAF-CON (mean = 10.82, 12% decrease) (see Figure 12).

For the POETS-Likelihood subscale there was not a significant difference between the conditions at follow-up ($F(2,35) = 1.62$, $p = .212$, $\eta^2 = .05$). From the adjusted pre-training level (mean = 17.20), comparing the estimated marginal means showed that SMP displayed the lowest scores at follow-up (mean = 12.00, 30% decrease), compared to TAF-CON (mean = 15.02, 13% decrease), or TAF-INC (mean = 15.74, 8% decrease) (see Figure 13).

From pre-training to follow-up, the hypotheses were partially upheld as TAF-INC displayed a significantly greater reductions than the other two conditions in TAF total and TAF-M (confirmed by post hoc analyses), but there was not a significant difference in TAF likelihood beliefs (TAF-LO, TAF-LS, or POETS-L), or moral beliefs related to primary obsessions (POETS-M).

Group differences in overall emotional distress to obsessions (Top-10 ROII-Distress and POETS-GE) at post-training.

To test hypothesis 2a., that TAF-INC would display significantly lower emotional distress to obsessions at post-training than the other two conditions, and SMP would display greater reductions than TAF-CON. We conducted a series of ANCOVAs for the Top-10 endorsed items of each participant on the ROII Distress Scale, as well as a separate analysis of the POETS-GE subscale, while controlling for baseline levels of target outcome measures. Levene's test and normality checks were carried out and the assumptions were met for all the following analyses. In looking at the Top-10 ROII-Distress items there was a marginally significant difference between conditions at post-training ($F(2,50) = 3.12$, $p = .053$, $\eta^2 = .09$). As significance was only slightly above threshold post hoc analyses were carried out. Post hoc tests (Bonferroni) showed that TAF-INC scored marginally lower than TAF-CON ($p = .053$), but not SMP ($p = 1.000$), and no difference was found between TAF-CON and SMP ($p = .307$). From the adjusted pre-training level (mean = 39.66), comparing the estimated marginal means showed that TAF-INC displayed

the lowest scores at post-training (mean = 39.77, .3% increase), compared to SMP (mean = 44.22, 12% increase), or TAF-CON (mean = 54.78, 38% increase) (see Figure 14).

Next, in looking at POETS-GE subscale scores there was a significant difference between conditions at post-training ($F(2,50) = 3.419$ $p = .049$, $\eta^2 = .07$). Post hoc tests (Bonferroni) showed that SMP scored significantly lower than TAF-CON ($p = .044$), but not significantly lower than TAF-INC ($p = .598$), and there was no difference between TAF-INC and TAF-CON ($p = .633$). From the adjusted pre-training level (mean = 21.05), comparing the estimated marginal means showed that SMP displayed the lowest scores at post-training (mean = 15.24, 28% decrease), compared to TAF-INC (mean = 17.85, 15% decrease), or TAF-CON (mean = 20.31, 4% decrease) (see Figure 15).

Results indicate our hypothesis that TAF-INC would display a significantly lower general emotional distress to obsessions was partially upheld, as TAF-INC displayed the significantly lower Top-10 ROII Distress scores, but TAF-INC and SMP did not significantly differ, and the SMP condition did not display significantly lower scores than TAF-CON. When looking at POETS-GE subscale scores there was a significant difference between conditions, but this difference was seen between SMP (largest mean reduction) and TAF-CON (smallest mean reduction).

Group differences in overall emotional distress to obsessions (Top-10 ROII-Distress and POETS-GE) at follow-up.

To test hypothesis 2b, that TAF-INC would display significantly lower emotional distress to obsessions at follow-up than the other two conditions, and SMP would display significantly lower scores than TAF-CON. We conducted a series of ANCOVAs for the Top-10 endorsed items of each participant on the ROII Distress Scale, as well as a separate analysis of the POETS-GE subscale, while controlling for baseline levels of target outcome measures. Levene's test and normality checks were carried out and the assumptions were met for all the following analyses. In looking at the Top-10 ROII-Distress items there was not a significant difference between conditions at follow-up ($F(2,38) = 1.16$, $p = .324$, $\eta^2 = .01$). From the adjusted pre-training level (mean = 40.25), comparing the estimated marginal means showed

that SMP displayed the lowest follow-up scores (mean = 31.00, 23% decrease), compared to TAF-CON (mean = 39.89, 1% decrease), or TAF-INC (mean = 40.03, 1% decrease) (see Figure 16).

Next, in looking at POETS-GE subscale scores there was not a significant difference between conditions at post-training ($F(2,35) = .184$, $p = .833$, $\eta^2 = .01$). From the adjusted pre-training level (mean = 20.12), comparing the estimated marginal means showed that SMP displayed the lowest follow-up scores (mean = 17.60, 13% decrease), compared to TAF-INC (mean = 17.87, 12% decrease), or TAF-CON (mean = 18.68, 7% decrease) (see Figure 17).

Hypotheses 2.b. was not upheld, as there was not a significant difference between conditions at follow-up related to emotional distress in either general obsessions (top-10 ROII Distress items) or to primary obsessions (POETS-GE). The lack of significant difference between the three conditions could indicate that the effects of a single training is not potent enough to carry training effects to a 1-month follow-up.

Group differences in SUDS and psychophysiological reactivity to a TAF stressor task: (1) subjective emotional reactivity (SUDS ratings), (2) mean overall HR, and (3) HRV by Time domain at post-training

To test hypothesis 3a, that from pre-training to post-training TAF-INC would display significantly reduced psychophysiological reactivity to a TAF stressor task than the SMP or TAF-CON conditions, and that SMP would display significantly reduced reactivity than TAF-CON, we conducted a series of ANCOVAs, while controlling for baseline levels of target outcome measures. Levene's test and normality checks were carried out and the assumptions were met for all the following analyses. We conducted ANCOVA analyses for subjective emotional reactivity (i.e. SUDS) ratings following the stressor task at post-training, while controlling for pre-training stressor task SUDS, but the differences between conditions were not significant ($F(2,43) = 1.72$, $p = .191$, $\eta^2 = .03$). From the adjusted pre-training level (mean = 42.37), comparing the estimated marginal means at post-training showed that SMP displayed the lowest SUDS (mean = 23.56, 44% decrease), compared to TAF-INC (mean = 23.81, 44% decrease), or TAF-CON (mean = 33.11, 22% decrease) (see Figure 18).

Due to low sample size of participants who completed the stressor task with interpretable HRV data, it was not appropriate to run a formal statistical test comparing conditions. We present the post-training stressor task means, standard deviations, and percent change from pre-training. For a further breakdown see Table 2. When comparing conditions on pre-to post scores TAF-INC (mean = 78.64, SD = 13.84, 5.0% decrease) displayed the lowest mean overall HR, followed by SMP (mean = 83.82, SD = 16.69, 4.3% decrease), and TAF-CON (mean = 87.72, SD = 11.70, 5.9% decrease).

Next, we examined RMSSD across conditions, with increases in HRV displaying reduced responses to stress. Results indicated TAF-INC displayed the largest increase in HRV (mean = 169.80, SD = 81.82, 101.9% increase), followed by TAF-CON (mean = 119.94, SD = 116.94, 79.2% increase), and finally SMP (mean = 141.74, SD = 189.59, 29.9% increase).

Next, we examined pNN50 across conditions, with increases in HRV displaying reduced responses to stress. Results indicated TAF-INC displayed the largest increase in HRV (mean = 43.03, SD = 21.97, 71.79% increase), followed by TAF-CON (mean = 31.15, SD = 23.03, 48.4% increase), and finally SMP (mean = 31.44, SD = 31.44, 19.2% decrease).

Findings indicate that there were no significant differences between conditions in SUDS reported during the post-training stressor task. Though, the TAF-INC and SMP conditions both experienced twice the amount of reductions as the TAF-CON condition in reported SUDS. Due to our low sample size, we were unable to properly test our hypotheses that TAF would display significantly greater reductions in psychophysiological reactions to a TAF stressor task from pre-to-post training.

Group differences in SUDS and psychophysiological reactivity to a TAF stressor task: (1) subjective emotional reactivity (SUDS ratings), (2) mean overall HR, and (3) HRV by Time domain at follow-up

To test hypothesis 3b, that from pre-training to follow-up, TAF-INC would display significantly reduced psychophysiological reactivity to a TAF stressor task than the SMP or TAF-CON conditions, and that SMP would display significantly reduced reactivity than TAF-CON, we conducted a series of ANCOVAs, while controlling for baseline levels of target outcome measures. Levene's test and

normality checks were carried out and the assumptions were met for all the following analyses. We conducted ANCOVA analyses for subjective emotional reactivity (i.e. SUDS) ratings following the stressor task at follow-up, while controlling for pre-training stressor task SUDS, but the differences between conditions were not significant ($F(2,28) = .58$, $p = .568$, $\eta^2 = .02$). From the adjusted pre-training level (mean = 42.62), comparing the estimated marginal means at post-training showed that TAF-CON displayed the largest reductions (mean = 21.70, 47% decrease), compared to SMP (mean = 26.30, 40% decrease), or TAF-INC (mean = 30.17, 26% decrease) (see Figure 19).

Due to low sample size of participants who completed the stressor task with interpretable HRV data, it was not appropriate to run a formal statistical test comparing conditions. For psychophysiological analyses from pre-to-follow-up we will present the follow-up stressor task means, standard deviations, and percent change from pre-training. For a further breakdown see Table 2. When comparing conditions on pre-to post scores on mean overall HR TAF-CON (mean = 89.60, SD = 9.50, 3.9% decrease) displayed the largest decrease, followed by SMP (mean = 85.97, SD = 11.00, 1.9% decrease), and TAF-INC (mean = 89.10, SD = 13.32, 7.6% increase).

Next, we examined RMSSD across conditions, with increases in HRV displaying reduced responses to stress. Results indicated TAF-CON displayed the largest increase in HRV (mean = 70.20, SD = 44.81, 4.9% increase), followed by TAF-INC (mean = 78.87, SD = 64.33, 6.2% decrease), and finally SMP (mean = 57.38, SD = 47.55, 47.4% decrease).

Next, we examined pNN50 across conditions, with increases in HRV displaying reduced responses to stress. Results indicated TAF-CON displayed the largest increase in HRV (mean = 25.00, SD = 19.32, 19.1% increase), followed by TAF-INC (mean = 16.83, SD = 19.91, 32.8% increase), and finally SMP (mean = 10.84, SD = 12.26, 72.1% decrease).

As SUDS ratings did not display a significant difference between conditions, we cannot conclude that the individual trainings had demonstrable effects carried to the 1-month follow-up. Additionally, due to low sample size, we were not able run our planned formal statistical tests on HRV outcomes.

Discussion

The contribution of TAF in OCD and many other anxiety disorders has been presented in many cognitive theories of these disorders, particularly the influence of TAF on the maintenance of obsessions and their negative impacts. In line with this literature, recent research has shown that TAF is a cognitive process that can be manipulated and reduced with intervention (Marino-Carper et al., 2010; Rassin et al., 2001, Thompson, 2013; Zucker et al., 2002). Consequently, the target of developing an intervention designed to modify the faulty interpretations of intrusive thoughts, such as TAF biases, is very likely to be a beneficial line of research to help those who suffer with distress and interference associated obsessional symptoms.

The novelty in the current proposal is the utilization of computers in CBM-I for TAF, incorporating an SMP training condition, as well as incorporating psychophysiological monitoring during the stressor task. The use of computerized interventions has many potential benefits, such as (i) the ability to reach people without psychological resources geographically close to them, (ii) treatments can be done in the privacy of one's home, and (iii) treatments currently have no cost associated with them. Additionally, to our knowledge, this is the first study to modify SMP to be used in a computerized CBM training, and it demonstrated itself to be a great credible comparison/placebo condition. SMP training was designed to indirectly reduce the severity of obsessions by reducing stress, through providing education about the causes of stress, its effects, and stress reduction techniques (i.e. increasing problem solving abilities, time management, organization, relaxation, interpersonal problem solving, and assertiveness; Woody et al., 2010). Important to our study, the SMP condition is a credible comparison condition as it likely facilitates reductions in measures of stress (and obsessions as well), but it does not target TAF. At post-training, SMP did not outperform TAF-INC on any indices of TAF belief but did outperform the TAF-CON condition. Additionally, the SMP condition did well at post-training and follow-up in reductions of emotional/distress response to intrusive thoughts. Future studies related to the reduction of cognitions tied to OCD should consider including an SMP comparison condition. Finally, this study addresses a gap in previous research by recording psychophysiological reactivity to a TAF

related stressor, in the form of HR recording before, during pre-training, post-training, and follow-up. Unfortunately, due to procedural issues we were not able to fully test our psychophysiological hypotheses with the current sample.

Overall, while controlling for baseline levels of target outcome measures, there was a significant difference between the TAF-INC, TAF-CON, and the SMP conditions in reducing TAF beliefs (TAF total, TAF-M, TAF-LO, TAF-LS, POETS-M, and POETS-L). The TAF-INC condition appears to have gained the most acute benefit from trainings, as not only were their reductions in general TAF significant, these reductions were often close to double what the next closest condition experienced. From pre-training to follow-up, while controlling for baseline levels of target outcome measures, the TAF-INC condition displayed significantly greater reductions in TAFS total and TAF-M, but there was no significant difference between conditions in TAF-LO, TAF-LS, POETS-M, or POETS-L. These findings are very similar to pre-to-post training findings in our previous study (Siwiec et al., 2017), with the exception that in the current study TAF-LO, TAF-LS, and POETS-L now displayed a significant difference between conditions. It is possible the increased potency of training in the current study (number of scenarios up from 70 to 100 and incorporating comprehension questions) may explain the group differences in TAF-LO, TAF-LS, and POETS-L as well as the replicated findings. At follow-up, this pattern for the TAF-INC condition held for TAF total scores and TAF-M scores, but likelihood domain scores (TAF-LO and TAF-LS) and primary obsession scores (POETS-M and POETS-L) did not display this pattern. Explanations for the follow-up analyses findings may be that TAF likelihood related beliefs, as well as TAF beliefs about personally-relevant obsessions, may be more resistant to change via a single session of CBM-I. In support, Rassin and Collegues (1999, 2000) suggested that TAF likelihood belief is more associated with obsessive compulsive symptoms than TAF moral beliefs. This association may indicate that an elevated level of TAF likelihood belief, which is more specifically associated with OC symptom severity rather than general emotional distress, is less amenable to change with a single CBM-I training. Relatedly, TAF biases associated with primary obsessions, such as those measured by the POETS, by definition indicate more firmly held beliefs, thus they may be more resistant to change.

As we saw a significant group difference in TAF-LO, TAF-LS, and POETS-L at post-training, it is possible the differences between conditions would have been more consistent if treatment potency was further increased.

What are some ways to increase potency of CBM-I training? Comparing post-training results from the previous study (Siwiec et al., 2017), by increasing the number of scenarios and including comprehension questions in the current study, we found additional TAF belief related group differences (TAF-LS and TAF-LO). In consideration of potency and the length of training, we believe the mean length of training of 35 minutes for TAF-INC was sufficient for a session. Therefore, we suggest that increasing the number of training sessions may help to display further group differences. It is unknown the number of trainings needed to sufficiently determine outcome change related to potency, but future studies may consider employing multiple sessions of CBM-I (e.g., 8 weekly sessions). In addition to increasing the number of training sessions, personalizing TAF scenarios for each participant could help increase potency. Obsessions, particularly primary obsessions, are idiosyncratic, thus a broad range of TAF scenario content may still not address a single participant's primary obsession. Assessing for and adding content to the training for each participant's primary obsession would likely strengthen the impact of training for each individual participant.

Comparing conditions in general emotional distress at post-training indicated that TAF-INC displayed a significantly greater reductions in Top-10 ROII Distress scores, but TAF-INC and SMP did not significantly differ, and the SMP condition did not display significantly greater decreases than TAF-CON. When looking at POETS-GE subscale scores there was a significant condition difference, but this difference was seen between SMP (largest mean reduction) and TAF-CON (smallest mean reduction). At follow-up there was not a significant difference between conditions related to either emotional distress to personally relevant obsessions (Top-10 ROII Distress items) or to primary obsessions (POETS-GE). The lack of significant difference between the TAF-INC condition at either time point was unexpected. As predicted, the SMP condition seemed to obtain benefit from their training in reduction of distress, which is consistent with past research findings that SMP is associated with reductions in with obsessional

severity and distress in non-clinical samples (Woody et al., 2003). The exact reason for this sustained reduction is unclear, but perhaps is tied with providing both psychoeducation about the connection between stress and increased obsessions, and useful techniques (i.e. progressive muscle relaxation and deep breathing techniques) which could be used acutely to stress reactions. The TAF-INC condition also displayed significantly a greater reduction in emotional distress to the TAF-CON condition, which is likely associated with the active trainings emphasis on reducing the perceived importance of intrusive thoughts. Findings from past research indicate that changes in interpretation bias are consistently associated with decreases in both distress and impairment (Mathews & Mackintosh, 2000; MacLeod, 2012). It is therefore likely the TAF-INC and SMP conditions experienced reductions for varying reasons, but further research is needed before conclusions can be asserted.

Additionally, at post and follow-up, TAF-INC was expected to display better indices of psychophysiological reactivity to a TAF stressor task than either the TAF-CON or SMP conditions. In regard to SUDS, which was reported verbally to study staff during the stressor task, this hypothesis was not upheld at either time points. Yet, at post-training the TAF-INC condition displayed a 43% reduction in SUDS, with SMP displaying a 44% decrease, and TAF-CON a 22% decrease. There may be a few potential explanations for this finding. At post-training the TAF-INC and SMP conditions experienced greater reductions in SUDS, as their trainings either challenged the validity of obsessions (TAF-INC), or provided strategies for dealing with distress them in the moment (SMP); either training theoretically could lead to a reduction in experienced distress to the stressor. The TAF-CON condition was not provided strategies to deal with the stressor thought, and their reductions could have been due to either habituation (engaging in the task two separate 5-minute exposures without attending to the thought and experiencing a reduction in SUDS), or an inoculating effect (completing the task a second time is not as unexpected and distressing). At follow-up, mean scores indicate the TAF-CON experienced a 47% decrease, SMP experienced a 35% decrease, and TAF-INC experienced a 30% decrease. A possible explanation for TAF-CON displaying the greatest reductions in SUDS is that the passage of time may have provided disconfirming evidence to them. Participants spent two 5-minute sessions wishing a loved

one was in a car accident, and when this did not occur, they may have realized this is evidence against the importance of these thoughts. This is in-line with the basic tenant of exposure therapy, where patients knowingly act to bring on feared consequences, and when they do not occur, they may need to adjust their determination of risk/danger.

In considering the psychophysiological data, unfortunately due to procedural errors, the majority of HRV data was uninterpretable. During the stressor task procedures participants wore a psychophysiological device which monitored and recorded their responses. Errors may have occurred from the device not being worn snuggly enough with sufficient moisture on the belt before recording started. We present in this manuscript very preliminary HRV findings, and outcomes should be interpreted with caution. Nevertheless, when considering the numeric change pattern of pre-to-post HRV indices, the TAF-INC condition displayed the largest *increases* in RMSSD (TAF-INC = 102%, TAF-CON = 79%, SMP = 30%), and pNN50 (TAF-INC = 71%, TAF-CON = 48%, SMP = 19%). When considering pre-to-follow-up mean score changes in HRV indices, the TAF-CON condition displayed the largest *increases* in RMSSD (TAF-CON = 5%, TAF-INC = 6% decrease, SMP = 47% decrease), and pNN50 (TAF-CON = 19%, TAF-INC = 33% decrease, SMP = 72% decrease). These very preliminary findings indicate that at post training the TAF-INC condition appears to display reduced reactivity to the stressor task, but this pattern does not hold at follow-up. Future research should continue to record and analyses HRV so that the effect of training can be thoroughly analyzed.

Considering the overall findings, what would be the mechanism of change underlying TAF-INC training? Cognitive theories of OCD propose it is not the occurrence nor content of the obsessive thoughts, but how the thought is interpreted and coped with which differentiates those who develop the disorder and those who do not (Rachman & De Silva, 1978; Rassin, Cougle & Muris, 2007). TAF-INC is a computerized cognitive reappraisal training designed to modify a subject's maladaptive cognitive appraisals about personally relevant emotional information by presenting obsessional thought scenarios, and providing/training healthier, less threatening interpretations (Williams et al., 2013). This process has been shown to lead to lower distress and impairment in past research (Mathews & Mackintosh, 2000), and

likely helped acutely reduce TAF belief and associated emotional reactions in the current study. However, an alternative explanation for overall symptom improvement in the TAF-INC condition, and to an extent the SMP condition, is demand characteristics. Through the consent procedure, participants were informed that the purpose of the study is to determine the degree to which an interpretation training can influence reactions to intrusive/distressing thoughts. It is conceivable that participants inferred what we were looking for and expecting improvements in scores. This expectation could have driven some participants help us satisfy our goals by reporting greater symptom improvement than they actually experienced from pre-training to post-training, and/or follow-up. To address this concern, during the post-training measures we did ask participants "Do you believe you were in a beneficial training condition?" (Yes = 2, Maybe = 1, and No = 0). Findings indicated a significant difference between conditions ($X^2 = 17.20$, $p = .002$), with TAF-INC mean = 1.60 (SD = .50), SMP mean = 1.47 (SD = .51), and TAF-CON mean = .84 (SD = .60). Although the TAF-INC and SMP conditions expressed that they thought their trainings beneficial, which is great, unfortunately, it means we cannot fully rule out the possible influence of demand characteristics from these findings. Additionally, the ordering of means by conditions (TAF-INC, then SMP, then TAF-CON) is consistent with the possibility that participants perceived relevance of the trainings in reducing obsessive thoughts and distress influenced their responses. Nevertheless, despite the possibility of expectancy effects, overall findings indicate some level of specificity in the two training conditions (TAF-INC vs. SMP) in that group differences in TAF symptom were largely observed in the TAF-INC condition, whereas SMP shows only a group difference in emotional distress without greatly affecting the level of TAF.

Limitations

The current study has some clear limitations. Firstly, several participants declined participation in the sentence completion stressor task at pre-training (TAF-INC = 2, TAF-CON = 2, SMP = 1), one TAF-INC participant declined at post-training, and three others at follow-up (TAF-INC = 1, TAF-CON = 2). When we asked these participants the reason they declined they reported that they felt the task was

too distressing for them. Future TAF studies should work to increase task acceptance by either modifying the current task, or incorporating a different behavioral challenge task.

Secondly, the study of undergraduates contained an unexpectedly high proportion of participants who had sought either psychological or drug treatment in the past (TAF-INC = 52.4%, TAF-CON = 57.9%, SMP = 58.8) or who were currently receiving psychological or drug treatment (TAF-INC = 28.6%, TAF-CON = 15.8%, SMP = 35.3%). The three conditions did not differ significantly in the amount of current treatment at pre-training ($X^2 = 1.85$, $p = .397$). However, participant treatment engagement was not followed systematically, so it is possible that changes may have occurred during study participation. Thus, the impact of possible treatment changes on current findings is also unknown.

Thirdly, we did observe a significant difference between study completers and study non-completers on baseline OCI-R Total scores. Mean scores for both completers and non-completers were above the OCI-R Total score cutoff of 21, indicating the likely presence of clinically relevant obsessive-compulsive symptoms (Foa et al., 2002). Yet, the number of completers versus non-completers did not display significant differences by condition, or by OCI-R Obsession scores, $F(2,55) = .197$. Given there was no difference in OCI-R Obsessing scores, it is likely the three conditions were similar in levels of obsessions and cognitive bias at baseline, and not influencing study outcomes.

Fourthly, the TAFS was used as the primary outcome measure in the study. While TAF-INC displayed significantly greater group differences at post-training and follow-up on most TAF analyses, it is not clear these differences were clinically meaningful. There are no established cutoff scores for the TAFS, only that higher scores are indicative of higher rates of TAF cognitions (Shafran et al., 1996). A limitation in this study design is in not having adequate functional outcome measures (i.e. YBOCS clinician rating) for both acute and long-term timepoints. This was due to the single session training design not allowing an adequate time window to track changes in functional outcomes, and, at this stage of research, the primary goal was to check on target change. The next step in this line of research will involve incorporating more adequate functional outcomes, that will help assess the clinical significance of TAF changes.

Lastly, we conducted per-protocol analyses, with no intent-to-treat analyses, although there were participants who dropped or withdrew from the study after randomization (mostly unreachable by email or phone call following post-training assessment). Participants with missing values were excluded in related data analyses by ANCOVA. Compared to intent-to-treat analyses, per-protocol analyses tend to produce more favorable treatment outcomes, as dropouts tend to present more unfavorable treatment responses (Gupta, 2011). Consequently, given the current findings supporting the most of the main study hypotheses, there is a chance intent-to-treat analysis would have displayed different findings.

Summary

Encouragingly, findings from the study suggest the effect of a single session of TAF-INC in acutely reducing TAF belief and associated distress. A logical next step in CBM-I for TAF research would be to implement more training sessions (e.g. 8-sessions), using a clinical sample with OCD, and include a longer-term follow-up (e.g. 6 months). Including a clinical OCD sample would not only allow for measurement of potential changes in TAF bias, but potentially display group differences in obsessive compulsive symptoms as well. As individuals with clinical OCD do not usually display spontaneous remission of symptoms, changes would lend support to the clinical utility of the training effects. A longer-term follow-up would allow us to examine the durability of training gains from TAF-INC. Additionally, due to the design and performance of the SMP condition, any TAF study should strongly consider including SMP as a comparison condition.

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APPENDIX A:

Figures

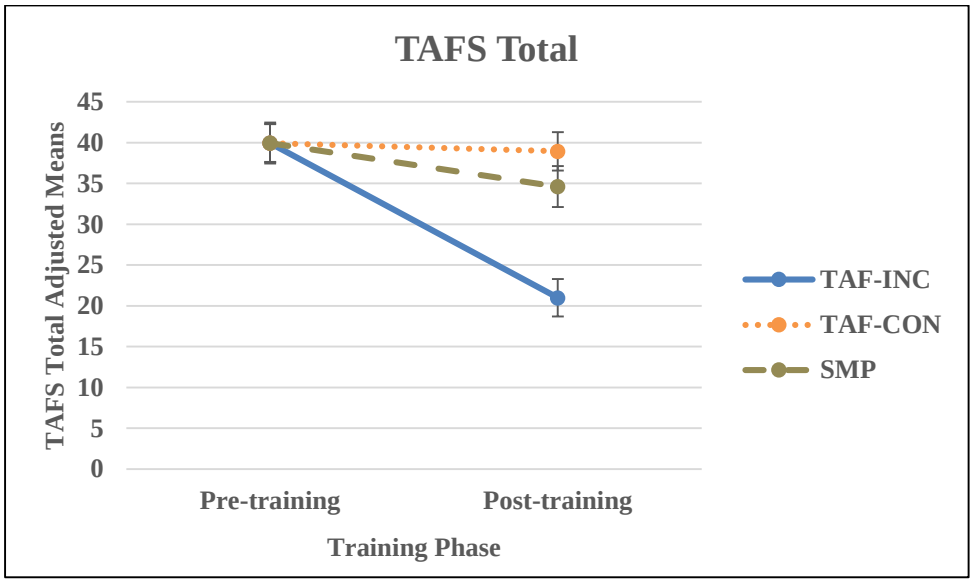

Figure 2. Pre- to Post-Training TAFS Total Scores

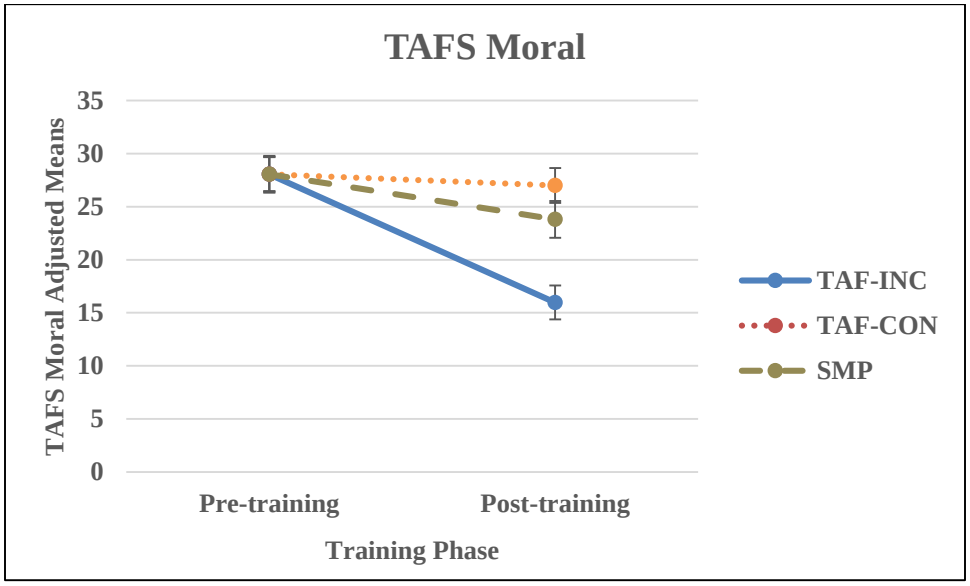

Figure 3. Pre- to Post-Training TAFS Moral Subscale Scores

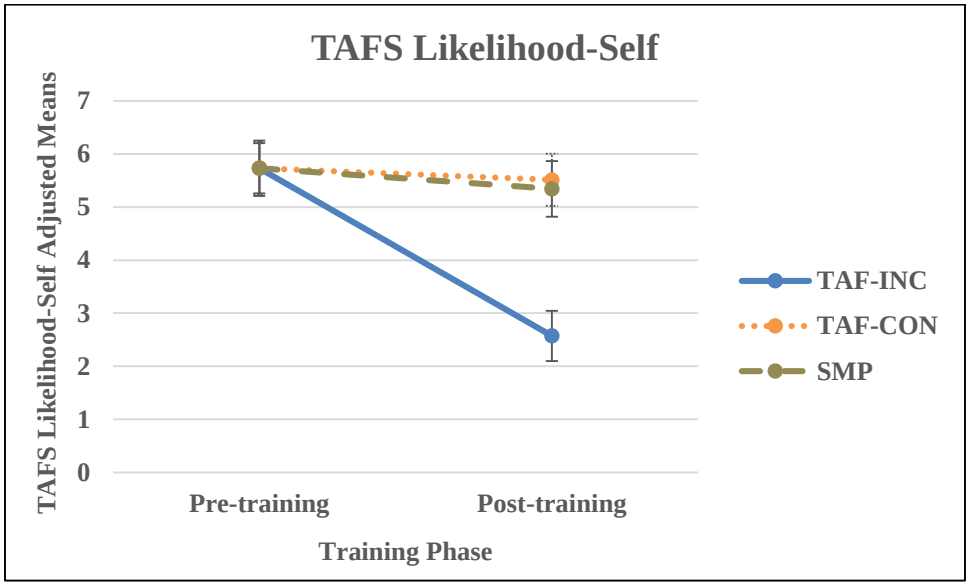

Figure 4. Pre- to Post-Training TAFS Likelihood-Self Subscale Scores

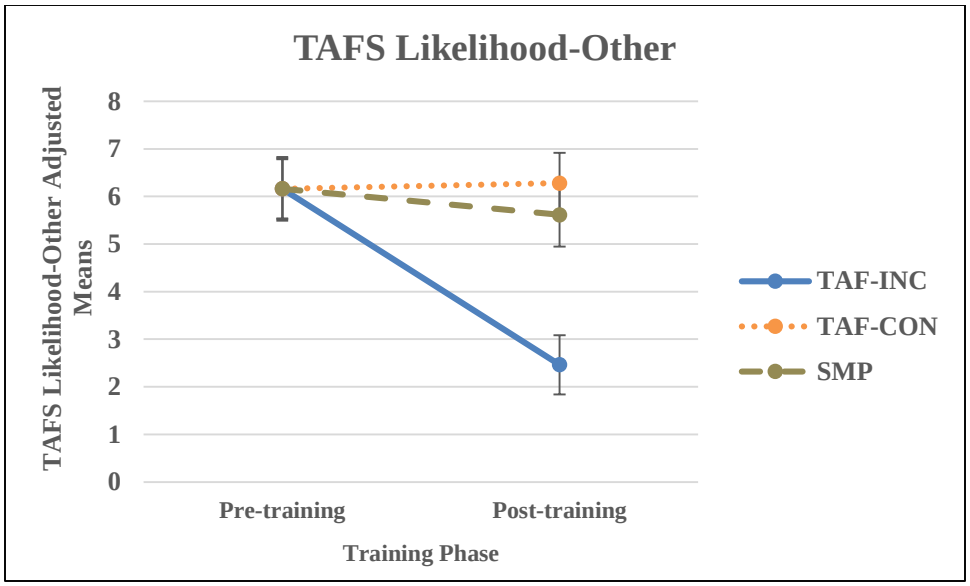

Figure 5. Pre- to Post-Training TAFS Likelihood-Other Subscale Scores

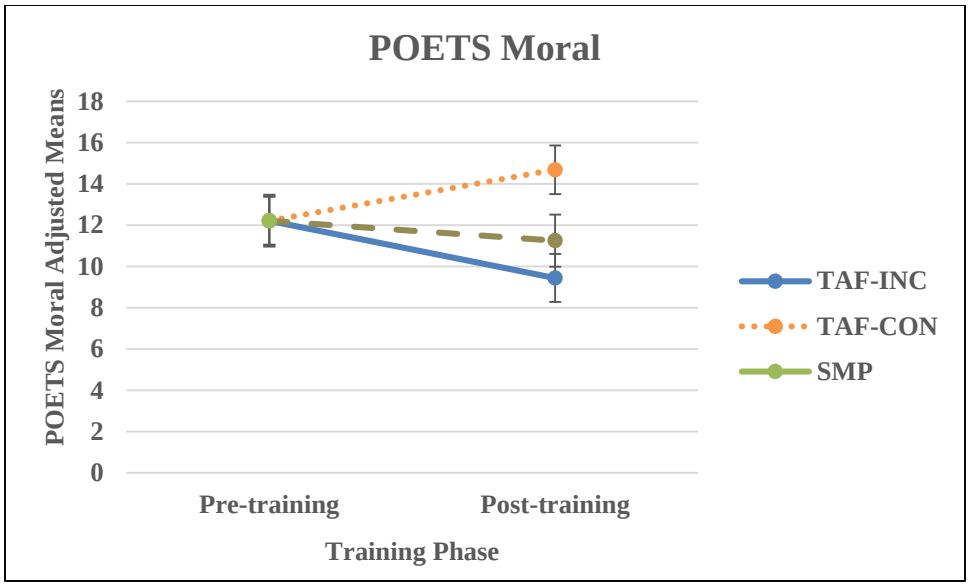

Figure 6. Pre- to Post-Training POETS Moral Subscale Scores

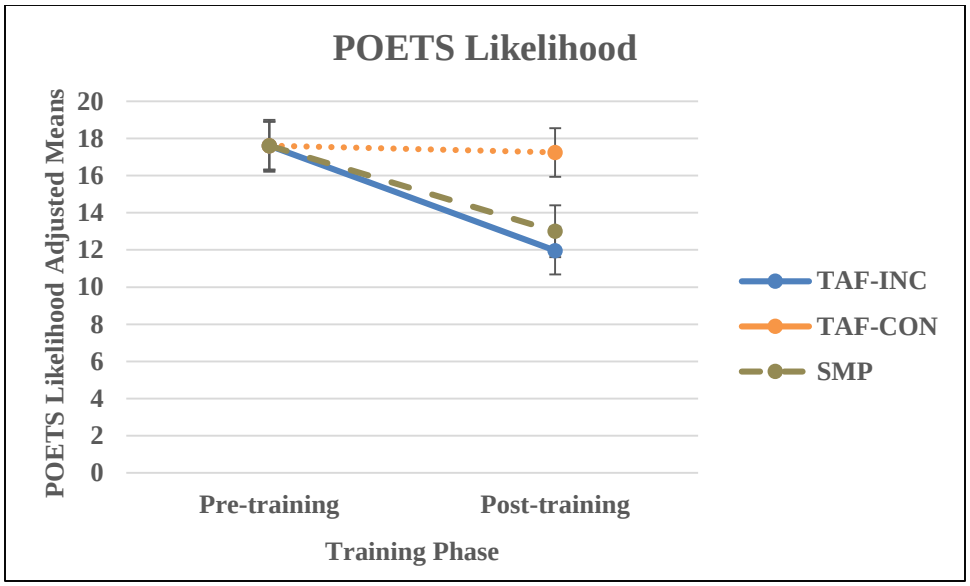

Figure 7. Pre- to Post-Training POETS Likelihood Subscale Scores

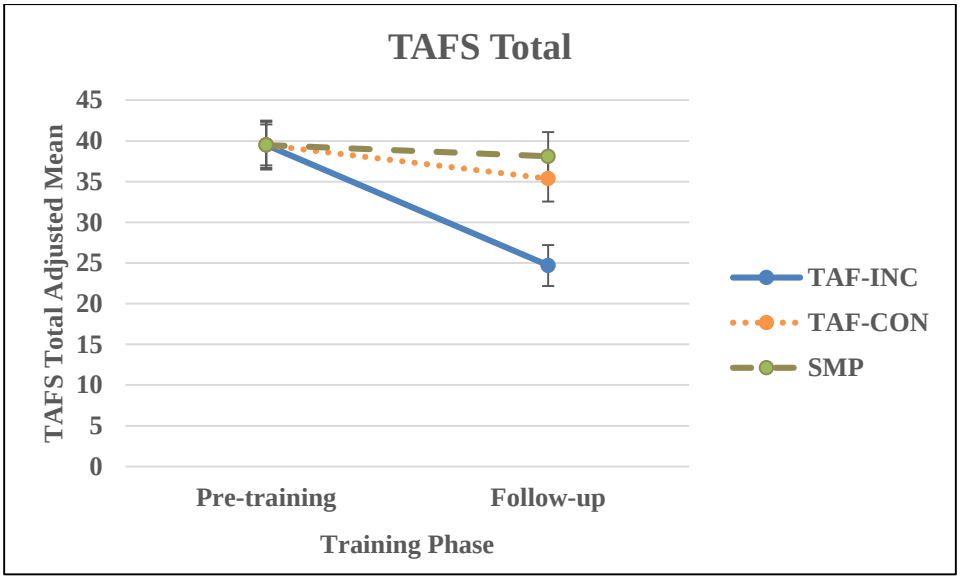

Figure 8. Pre- to Follow-up TAFS Total Scores

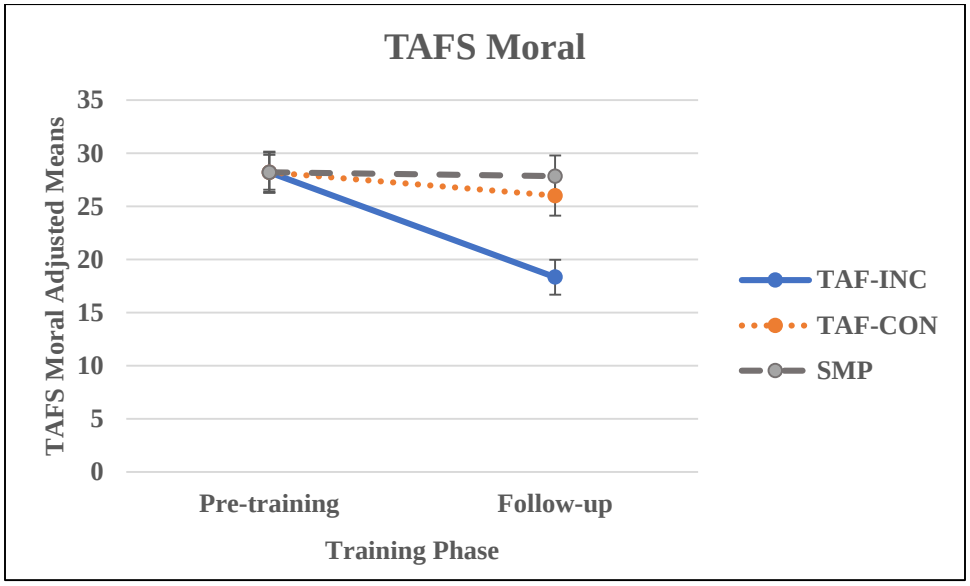

Figure 9. Pre- to Follow-up TAFS Moral Scores

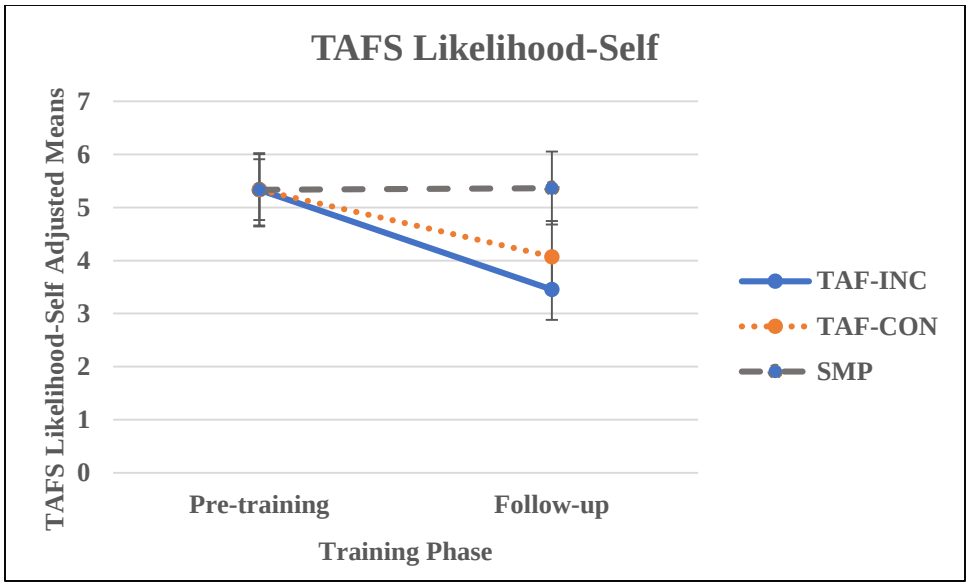

Figure 10. Pre- to Follow-up TAFS Likelihood-Self Scores

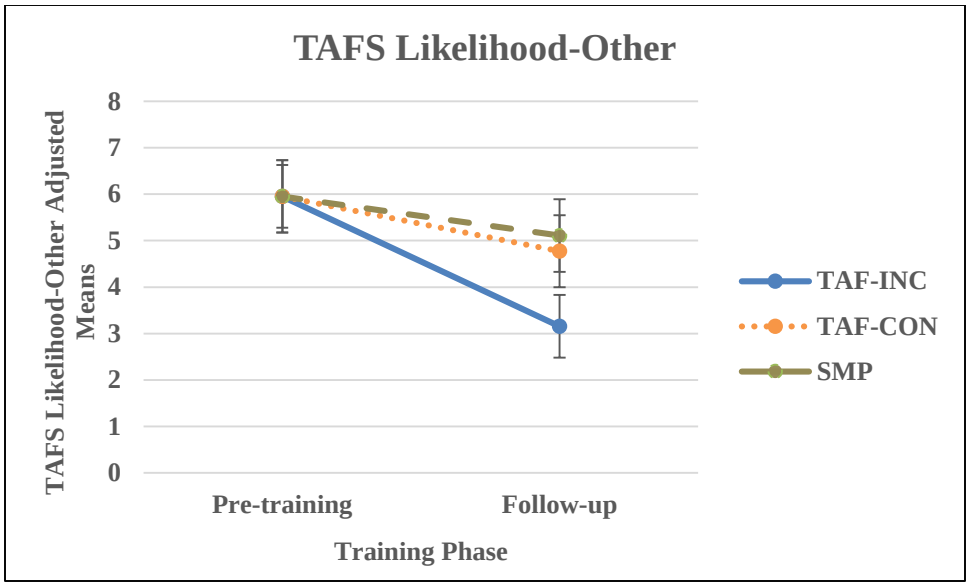

Figure 11. Pre- to Follow-up TAFS Likelihood-Other Scores

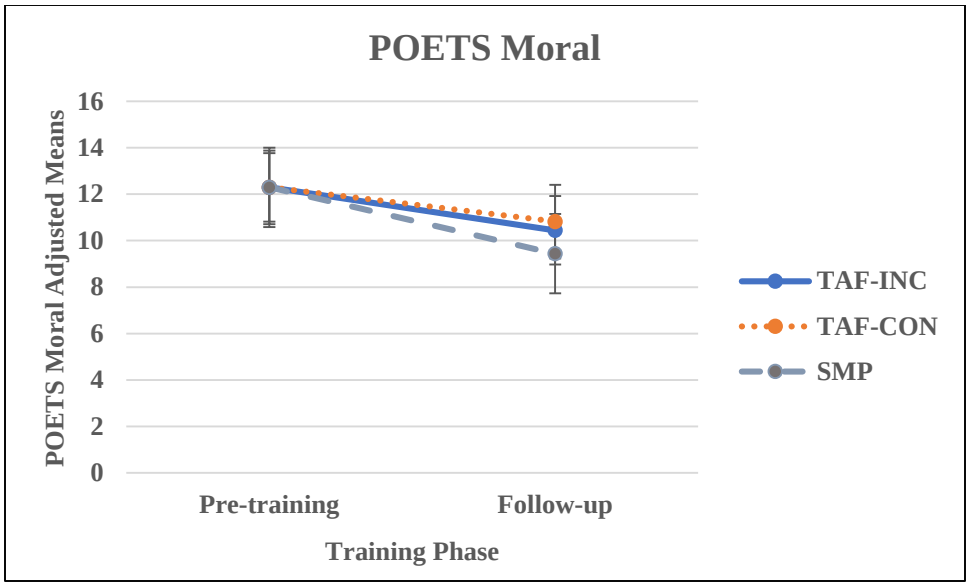

Figure 12. Pre- to Follow-up POETS Moral Scores

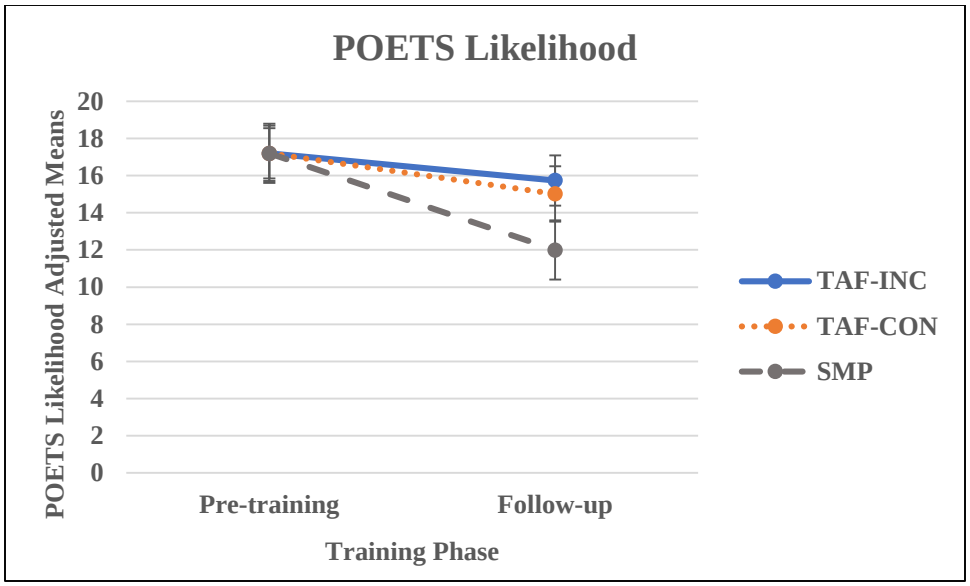

Figure 13. Pre- to Follow-up POETS Likelihood Scores

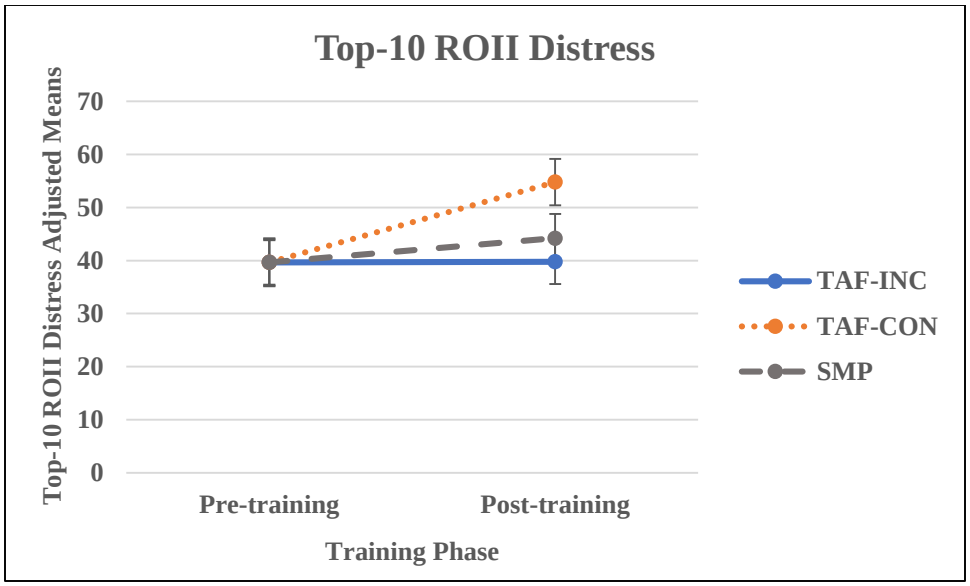

Figure 14. Pre- to Post-Training Top-10 ROII-Distress Scores

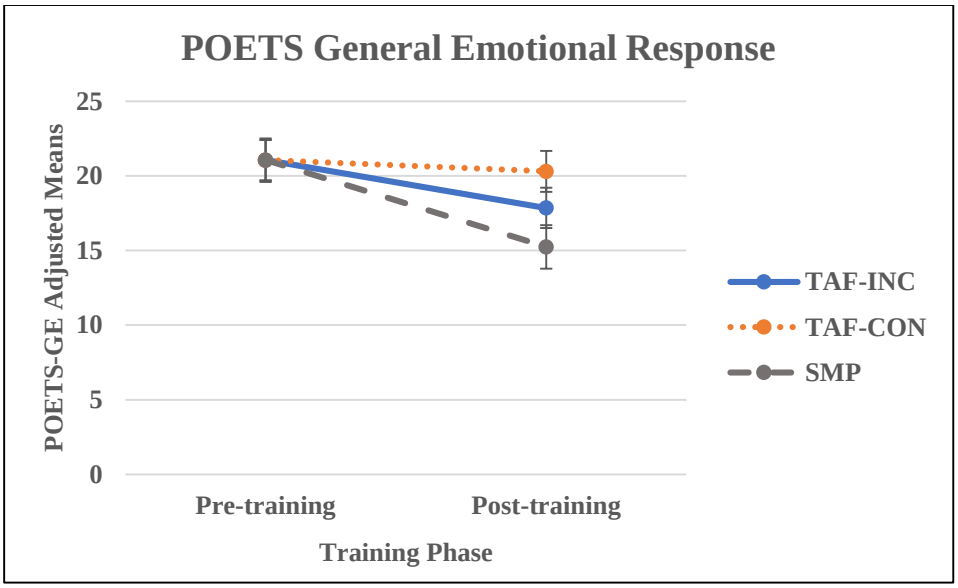

Figure 15. Pre- to Post-Training POETS General Emotional Response Scores

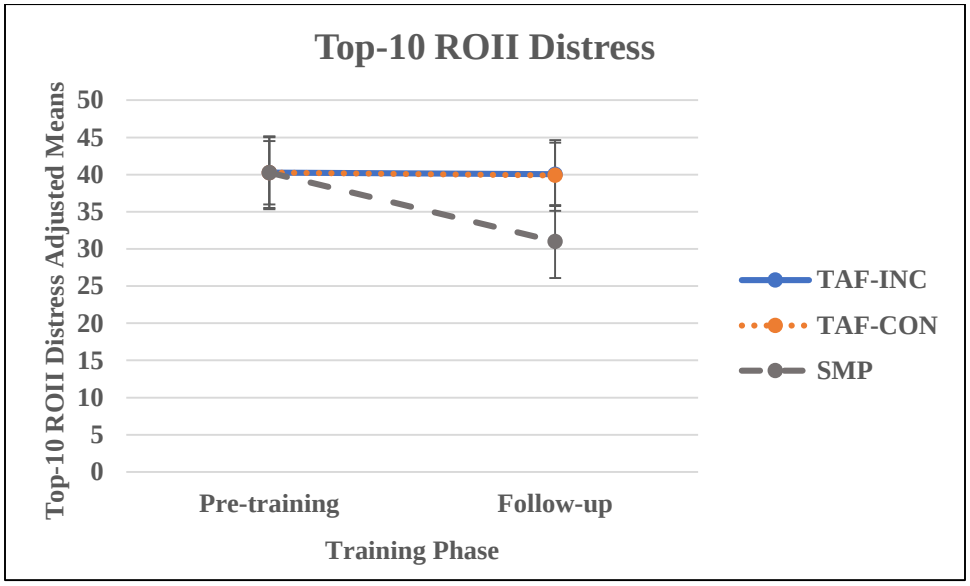

Figure 16. Pre- to Follow-up Top-10 ROII-Distress Scores

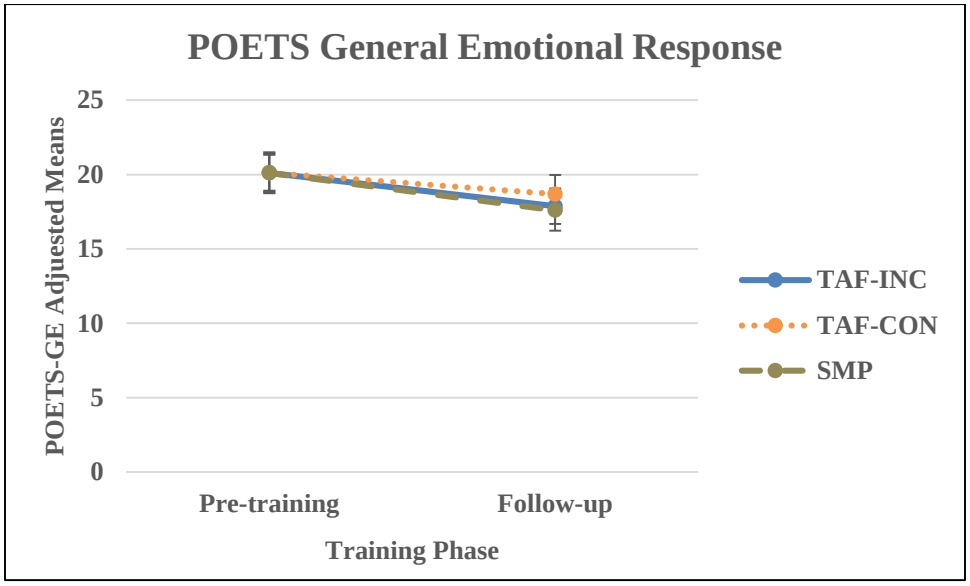

Figure 17. Pre- to Follow-up POETS General Emotional Response Scores

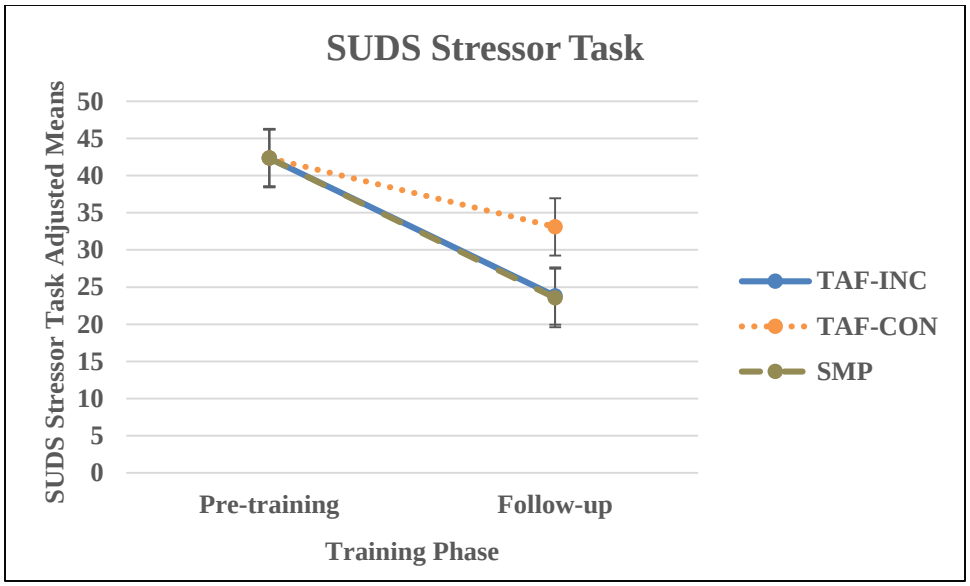

Figure 18. Pre- to Post-Training SUDS Total Scores

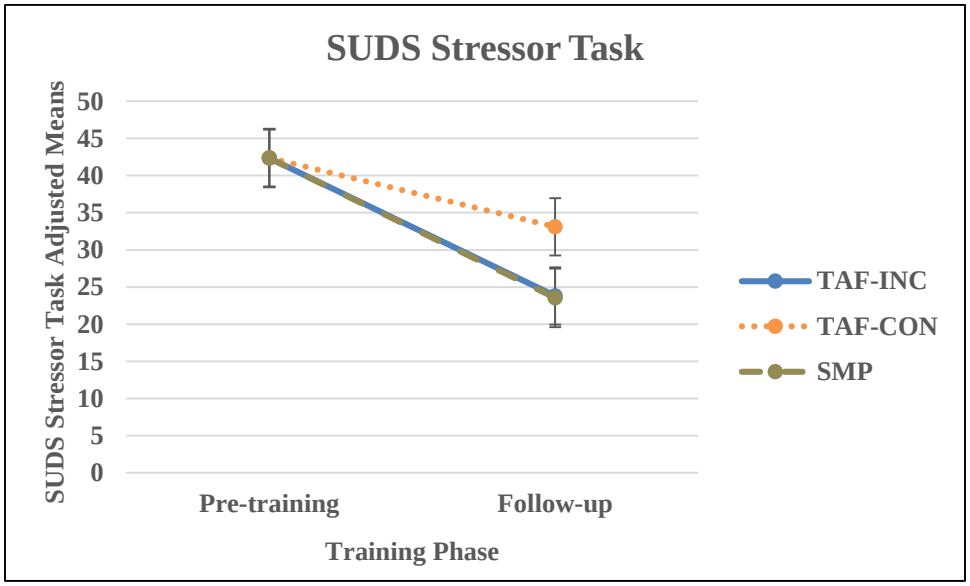

Figure 19. Pre- to Follow-up SUDS Total Scores

APPENDIX B:

Training Scenario Examples

TAF Incongruent Training (TAF-INC)

1. I was eating lunch with my coworker. All of a sudden, a thought of poking my coworker's eye with my fork came into my head. Having this thought in my mind is (meani_gl_ss), as everyone has these thoughts but they almost always never lead to any action.

   Based on this scenario, does having this thought once make it very significant? (Yes/No)

2. I was listening to music the other day and I kept having thoughts about having an affair with my partner's best friend. Having this thought in my mind is (irr_leva_t), and if I am distressed by these thoughts it indicates I am very unlikely to act on them.

   Based on this scenario, does having this thought mean you'd like to have this affair? (Yes/No)

3. Yesterday I had the thought that I should go to a church and pee in the holy water. Having this thought reflects nothing about me, as it is very (_nlik_ly) I will act on it.

   Based on this scenario, does having this thought mean nothing? (Yes/No)

TAF Congruent Training (TAF-CON)

1. I was eating lunch with my coworker. All of a sudden, a thought of poking my coworker's eye with my fork came into my head. Having this thought in my mind is (unac_ept_ble). If my friend knew what I was thinking he/she would have thought I am dangerous and unpredictable.

   Based on this scenario, if your friend knew what you were thinking would he/she think you are dangerous? (Yes/No)

2. I was listening to music the other day and I kept having thoughts about having an affair with my partner's best friend. Having this thought in my mind is (imm_r_l) and if my partner knew about this thought he/she would think I am untrustworthy.

   Based on this scenario, if your partner knew what you were thinking, would they still trust you? (Yes/No)

3. Yesterday I had the thought that I should go to a church and pee in the holy water. Having this thought means I am a (s_nn_r) and if anyone knew about this thought they would think I am a terrible person.

   Based on this scenario, does having the urge to pee in the holy water make you a sinner? (Yes/No)

Stress Management Training (SMP)

1. By redirecting your attention, you will learn to dismiss worrisome thoughts; that is, even though the worrisome thoughts may still be present, the fact that you are not giving them all of your attention and, instead, directing your attention to the physical sensations of relaxation, will mean that you are teaching yourself that those worrisome thoughts are not (i_port_nt) and that you are not controlled by them.

   Will redirecting you attention from worrisome thoughts give you additional control over them? (Yes/No)

2. The experience of physical tension and pain is often experienced by people who report chronic worry. Physical tension can be a contributor and a result of anxiety and worry. For this reason, learning to relax physically is one pathway to (interr_pti_g) the cycle of anxiety and worry.

   Is learning to relax physically thought to influence a reduction in anxiety and worry? (Yes/No)

3. Relaxation should become a regular part of your daily schedule. Your initial response might be, "I don't have time to relax. There are far too many other things that have to get done." This sense of time pressure only (_dd_) to your anxiety.

   Is it important to set aside time to relax in your daily schedule? (Yes/No)

Curriculum Vitae

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Work Address:
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Pearse Hall
Room 381
2513 East Hartford Avenue
Milwaukee, WI 53211

Education (GPA: 3.94):

- APA Accredited Internship, Stony Brook University Consortium, Aug. 2018 – Present.
- Ph.D. Clinical Psychology, University of Wisconsin-Milwaukee, Sept. 2012 – Present.
- M.S. Psychology, University of Wisconsin-Milwaukee, Dec. 2015.
- M.A. Psychology, Boston University, May 2009.
- B.A. Psychology, Boston University, May 2006.

Awards and Honors:

- 2019 UWM Graduate Student Travel Award ($175)
- 2017 AGSIP Travel Grant to ABCT Conference ($540)
- 2017 UWM Graduate Student Travel Award ($400)
- 2016 UWM Department of Psychology Summer Research Fellowship ($3,218)
- 2015 AGSIP Travel Grant to ABCT Conference ($350)
- 2015 UWM Graduate Student Travel Award ($100)
- 2014 AGSIP Travel Grant to ABCT Conference ($300)
- 2014 UWM Graduate Student Travel Award ($375)
- 2012 UWM Graduate Student Travel Award ($450)

Publications:

Siwiec, S.G., Riemann, B.C., & Lee, H.J. (In Review). Predictors of acute outcomes for intensive residential treatment of obsessive-compulsive disorder. Manuscript submitted for publication.

Lee, H.J., Espil, F.M., Bauer, C.C., **Siwiec, S.G**., & Woods, D.W. (2018). Computerized response inhibition training for children with trichotillomania. *Psychiatry research, 262*, 20-27.

Siwiec, S.G., Davine, T.P., Kresser, R.C., Rohde, M.M., Lee, H.J. (2017). Modifying thought-action fusion via a single-session computerized interpretation training. *Journal of Obsessive-Compulsive and Related Disorders, 12*, 15-22.

Goetz, A.R., Davine, T.P., **Siwiec, S.G.**, & Lee, H.J. (2016). The functional value of preventative and restorative safety behaviors: A systematic review of the literature. *Clinical Psychology Review, 44*, 112-124.

Lee, H.J., Goetz, A. R., Turkel, J. E., & **Siwiec, S. G**. (2014). Computerized attention retraining for individuals with elevated health anxiety. *Anxiety, Stress & Coping, 28*(2), 226-237.

Book Chapter:

Lee, H.J. & **Siwiec, S.** (2016). *Thought-action fusion*, The Sage Encyclopedia of Abnormal and Clinical Psychology, Thousand Oaks, CA, SAGE Publications Inc.

Posters and Presentations:

Siwiec, S., Hahn, L.K., Arciniegas, J., Bento, C.D., & Lee, H.J. (2019, March). Computerized Cognitive Bias Modification (CBM) for Thought-Action Fusion at a 1-Month Follow-up. Poster to be presented at the 39th Annual ADAA Conference, Chicago.

Siwiec, S., Rohde, M., Kresser, R., Dietzen, K., Davine, T., & Lee, HJ. (2017, November). The Relation of the NIMH Trichotillomania Impairment /Global Scale to Other Common Measures of Trichotillomania. Poster presented at the 51st Annual ABCT Convention, San Diego.

Berlin, G., **Siwiec, S,** Stock, C., & Lee, HJ. (2016, October). Harm avoidance, incompleteness, and general symptom factors in OCD. Poster presented at the 50th Annual ABCT Convention, New York.

Siwiec, S., Kresser, R., Rohde, M., & Lee, HJ. (2015, November). Thought-action fusion reduction following a single session of interpretation training. Poster presented at the 49th Annual ABCT Convention, Chicago.

Siwiec, S., Rohde, M., Zupek, S., Goetz, A., Park, M.Y., & Lee, H.J. (2015, November). Pulling styles and impulse control in youth with trichotillomania. Poster presented at the 49th Annual ABCT Convention, Chicago.

Siwiec, S., Rohde, M., Zupek, S., Goetz, A., Park, M.Y., & Lee, H.J. (2015, November). Style of pulling in youth trichotillomania and its association with various clinical symptoms. Poster presented at the 49th Annual ABCT Convention, Chicago.

Siwiec, S.G., Goetz, A., Davine, T.P., Kresser, R., Rohde, M., & Lee, H.J. (2014, November). Lowering thought-action-fusion conviction through computerized interpretation training. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Siwiec, S., Davine, T.P., Goetz, A., Kresser, R., Standal, B., & Lee, H.J. (2014, November). Development of the primary obsession evaluation for thought-action-fusion scale. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Siwiec, S., Zupek, S., Park, M.Y., Bilkey, S., Espil, F., Goetz, A., & Lee, H.J. (2014, November). Automatic versus focused hair pulling and their differential association with severity of trichotillomania. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Siwiec, S.G., Park, M.Y., Zupek, S., Bilkey, S., Espil, F.M., Goetz, A., Lee, H.J. (2014, November). Psychometric properties of the NIMH trichotillomania severity rating scale for youths with trichotillomania. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Kresser, R., **Siwiec, S**., Standal, B., Rhode, M., & Lee, H.J. (2014, April). The use of computerized interpretation training to impact thought-action-fusion. Poster presented at the UW-System Symposium for Undergraduate Research & Creative Activity, Milwaukee.

Davine, T., Turkel, J. E., **Siwiec, S. G.**, Goetz, A., Spencer, S., & Lee, H-J. (2014, November). Evaluating the relevance of 'not just right' experiences for specific symptom domains of OCD. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Davine, T., Turkel, J. E., **Siwiec, S. G.**, Goetz, A., Rohde, M., & Lee, H-J. (2014, November). Autogenous and reactive obsessions and their association with different types of OCD symptoms. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Davine, T., Turkel, J. E., Goetz, A., **Siwiec, S. G.**, Janichek, B., & Lee, H-J. (2014, November). How they differ: Examining response inhibition measures in individuals with OCD. Poster presented at the 48th Annual ABCT Convention, Philadelphia.

Siwiec, S.G. Naragon-Gainey, K., Gallagher, M.W., & Brown, T.A. (2012, November). Longitudinal prediction of impairment from baseline diagnosis of anxiety and mood disorders. Poster presented at the 46th Annual ABCT convention, National Harbor.

Naragon-Gainey. K., Gallagher, M.W., **Siwiec, S.G.,** & Brown, T.A**. (**2012, November). Unique longitudinal associations of anxiety disorder constructs with psychosocial impairment. Poster presented at the 46th Annual ABCT convention, National Harbor.

Siwiec, S.G., McHugh, R.K., Murray, H.W., Otto, M.W. (2010, November). The Impact of Negative Affect on Impulsivity. Poster presented at the 44th Annual ABCT convention, San Francisco.

Siwiec, S.G., Fairholme, C.P., Schonwetter, S.W., Halmo, R., and St. Paul, M.S. (2009, November). Emotional avoidance, sleep-related safety behaviors, and comorbid insomnia: A meditational analysis. Poster presented at the 43rd Annual ABCT convention, New York City.

Halmo, R, Fairholme, C.P., **Siwiec, S.G.**, St. Paul, M.S., Schonwetter, S.W. (2009, November). Comorbid insomnia as a transdiagnostic process among emotional disorders: The role of neuroticism and sleep effort. Poster presented at the 43rd Annual ABCT convention, New York City.

Fairholme, C.P., Farchione, T., Schonwetter, S.W., Halmo, R, St. Paul, M.S, and **Siwiec, S.G.** (2009, November). Emotion dysregulation in the maintenance of comorbid insomnia: The role of emotion suppression and cognitive reappraisal. Poster presented at the 43rd Annual ABCT convention, New York City.

Schonwetter, S.W., Fairholme, C.P., St. Paul, M.S., **Siwiec, S.G.**, and Halmo, R. (2009, November). Comorbid insomnia as a transdiagnostic process among emotional disorders: The role of anxiety sensitivity. Poster presented at the 43rd Annual ABCT convention, New York City.

St. Paul, M.S., Fairholme, C.P., Halmo, R., **Siwiec, S.G.**, and Schonwetter, S.W. (2009, November). Relationship of insomnia-type sleep difficulties and emotional disorder severity: Associated risk for DSM-IV disorder constructs. Poster presented at the 43rd Annual ABCT convention, New York City.

Research Experience:

Aug. 2018 – Present, NASA & Stony Brook Star Study, Mind Body Clinical Research Center at Stony Brook University

Role: Therapist

- Missions to Mars are expected to last 2.5 years with a crew of 6-7 astronauts, and longer missions to the outer solar system may last 10+ years. Astronauts will face chronic stressors including separation from loved ones, living and working in extreme environments, loss of natural day/light cycles, partial gravity, Earth being out of sight, and persistent threats of danger such as exposure to radioactivity. Long-duration missions a lack of real-time communication with Earth. These mission will have communication time lapses with earth of 20-40 minutes. Little is known about how to provide psychological support when real-time communication is not possible. In the absence of effective coping skills, these stressors can lead to psychological and behavioral health conditions such as depression, anxiety and sleep problems.
- Interns provided telehealth services to participants over a seven week period on a daily. The content of these services ranged from providing psychoeducation about identifying stress, anxiety, and depression, to providing skill building for organization, relaxation, anxiety and stress reduction, to proper sleep hygiene, and even assertive communication skills.

July. 2017 – July. 2018, Dissertation Study, Examining Interpretation Training for Modifying Thought-Action Fusion: A Randomized Experimental Trail

Role: Principle Investigator

- Conceptualized the study and procedures, obtained IRB approval, set up study databases, set up study computerized measure batteries at baseline, trainings, and follow-up, created the computerized interpretation training used during the three study trainings, involved as an IE for assessment of OC symptoms at baseline and follow-up, and oversaw RAs in their study duties to both contact and run participants through procedures, as well as update and check study data.
- Involved in the submission and presentation of study findings during poster sessions at both regional and national conferences.

Aug. 2016 – Present, Cognitive Bias Modification for OCD Using Mobile Technology, Rogers Memorial Hospital.

Role: Primary Diagnostic Interviewer

Supervisors: Bradley Riemann, Ph.D. & Nader Amir, Ph.D.

- Involved in the running of community based treatment studies for both obsessive-compulsive disorder (OCD) and major depressive disorder (MDD). Both studies incorporate cognitive bias modification (CBM) training using smart phone technology. I conduct study assessments using the SCID, and diagnosis specific YBOCS, HAM-D, and Sheehan Suicidality Tracking Scale (S-STS). Additionally, I coordinate and plan study activities, writing and submitting to the IRB, data analysis, and will be involved in manuscript preparation.

Nov. 2013 – Jan. 2016, Master's Thesis, Cognitive Bias Modification Training for Thought-Action-Fusion, University of Wisconsin-Milwaukee.

Role: Principle Investigator

- Conceptualized the study and procedures, obtained IRB approval, set up study databases, set up study computerized measure batteries at baseline, trainings, and follow-up, created the computerized interpretation training used during the three study trainings, involved as an IE for assessment of OC symptoms at baseline and follow-up, and oversaw RAs in their study duties to both contact and run participants through procedures, as well as update and check study data.
- Involved in the submission and presentation of study findings during poster sessions at both regional and national conferences.

Aug. 2013 – Present, Online Child Trichotillomania Study, University of Wisconsin-Milwaukee

Role: Study Coordinator

Principal Investigator: Han Joo Lee, Ph.D.

- Involved in the initial full eligibility assessment of all study participants, including the Trichotillomania Diagnostic Interview (TDI), MINI-KID, and Clinical Global Impression Scale (CGI).
- Also involved in the day to day coordination of the study including updating the study database, contacting and scheduling participants, coordinating with the study IE for assessments, problem solving any difficulties participants encountered with completing study procedures, managing RAs and their duties, and managing study data collection and interpretation.

Sept. 2012 – Jan. 2014, Social Anxiety Study, University of Wisconsin-Milwaukee

Role: Primary Diagnostic Interviewer

Principal Investigator: Han Joo Lee, Ph.D.

- Involved in conducting structured clinical interviews at baseline and post training periods including the MINI, WASI, and CGI. Additionally, involved in manuscript preparation, IRB submissions, and attending weekly supervision meetings for the lab.

June 2011 – June 2012, Classification of Depression and Anxiety Lab (CODA), Boston University

Role: Senior Research Technician

Principal Investigator: Timothy A. Brown, Psy.D.

- Responsibilities include data and protocol management for the NIMH Funded Grant (R01 MH039096). Additional responsibilities include the generation of monthly retention reports,

delegation of research and administrative tasks to study volunteers, recruitment and representation for the study and the Center at off-site locations (e.g. community health centers, university wellness fairs), retrieval, storage, and shipment of blood and sputum samples for DNA collection, and transcribing weekly lab meeting minutes.

Sept. 2010 – June 2012, Efficacy Evaluation of a Unified Transdiagnostic Treatment for Anxiety Disorders, Boston University

Role: Research Extern

Supervisors: David H. Barlow, Ph.D. & Todd Farchione, Ph.D.

- Involved in database creation and the construction of forms, measures, and procedures used in a NIMH R01 (MH090053-01) funded study focused on evaluating the efficacy of a unified transdiagnostic treatment for anxiety disorders.

Feb. 2010 – June 2012, Translational Research Program, Boston University

Role: Volunteer Research Technician

Supervisors: Michael W. Otto, Ph.D. & Heather W. Murray, Ph.D.

- Involvement in a study analyzing the impact of negative affect on impulsive behavior. Responsibilities and contributions include study design and hypothesis generation, managing the Institutional Review Board application, recruitment, documentation, database management, study implementation, and data analysis.

Jan. 2009 – Nov. 2009, Center for Anxiety and Related Disorders at Boston University

Role: Volunteer Research Technician

Supervisor: Todd Farchione, Ph.D.

- Coordination and implementation of a study evaluating insomnia as a transdiagnostic process occurring across the range of emotional disorders. Additionally, working with current and prospective research studies including hypothesis generation and conference presentations.

Sept. 2008 – Sept. 2009, Center for Anxiety and Related Disorders at Boston University Role: Volunteer Research Technician

Supervisor: Todd Farchione, Ph.D.

- Research technician on an NIAAA R01 funded study comparing CBT and venlafaxine in the treatment of patients with comorbid alcohol and anxiety disorders. Responsibilities included database management, data entry in SPSS, and coding.
- Research technician on an NIMH R34 (MH 070693) funded study developing the Unified Protocol, a transdiagnostic treatment for emotional disorders. Responsibilities included database management, data entry in SPSS, coding, and developing session materials for therapists.

Clinical Experience:

Scheduled for April. 2019 – July. 2019 – Obesity/Disordered Eating Clinic, Stony Brook University Hospital.

Role: Therapist

Supervisor: Genna Hymowitz, Ph.D.

- The Obesity/Disordered Eating Clinic provides pre-surgical psychiatric diagnostic evaluations and pre- and post-surgical interdisciplinary skills training groups in an outpatient interdisciplinary setting. At the clinic, interns and psychologists work alongside surgeons, dietitians, physical therapists, nurses, and nurse practitioners in an interdisciplinary setting, allowing for informal and formal consultations regarding treatment planning for patients. Patients served by this clinic have been diagnosed with obesity and have a number of co-morbid chronic medical and psychological/psychiatric conditions. Patients come from a variety of socioeconomic, racial, and ethnic backgrounds.
- Psychological services CBT based and include pre-bariatric surgery psychiatric diagnostic evaluations, and assessment and treatment of obesity, disordered eating, chronic pain, maladaptive health behaviors affecting general medical conditions, anxiety disorders, depressive disorders, stress related problems, and difficulties related to adjustment following bariatric surgery.
- Interns conduct comprehensive psychological evaluations with bariatric surgery candidates, conduct pre- and post-surgery groups, and participate in inter-disciplinary team meetings to coordinate patient care.

Dec. 2018 – April. 2019 – Inpatient Psychiatry Unit, Stony Brook University Hospital

Role: Therapist

Supervisor: Andrew Deptula, Ph.D.

- It is a 30-bed unit designed for the acute short-term stabilization treatment of adult inpatients with a variety of psychiatric and behavioral problems including suicidality, bipolar disorder, schizophrenia, depression, and severe anxiety disorders.
- I work closely with a psychologist and with a multidisciplinary team (attending and resident psychiatrists, psychiatric nurses, post-doctoral psychologists, behavioral health specialists, occupational therapists, music therapists, and social workers) to evaluate and care for patients on the Inpatient Psychiatry Unit. Primary duties are to lead a skills group with a focus on anger management, as well as a morning mindfulness meditation. I also work with individual patients who are amenable to CBT. Additionally, I have the opportunity to attend patient case conferences with the psychiatry team, and I attend weekly hospital grand round presentations.

Aug. 2018 – Present, Dialectical Behavioral Treatment at the Mind Body Clinical Research Center (MB-CRC), Stony Brook University

Role: Therapist

Supervisors: Brittain Mahaffey, Ph.D. and Adam Gonzalez, Ph.D.

- At the MB-CRC Interns work with adult populations and provide supervised individual psychological diagnostic assessments and individual CBT-based psychotherapy for mood and anxiety disorders, and Dialectical Behavioral Therapy for patients with a primary personality disorder diagnosis, most of whom engage in self-harm and endorse some suicidality.
- I also co-lead group-based psychotherapy including a DBT group, and a Stress Management and Resilience Training Group (SMART).

Aug. 2018 – Present, Consultation and Liaison (C&L) Psychiatry, Stony Brook University Hospital

Role: Therapist

Supervisors: Cynthia Cervoni, Ph.D. and Tamara Welikson, Ph.D.

- The C&L service is comprised of psychologists, psychology interns, physicians, clinical nurse specialists, medical and physician assistant students, fellows from psychiatry, neurology, family medicine, geriatric medicine and geriatric psychiatry.
- The C&L team provides psychiatric consultation throughout the hospital. The most common problems faced are related to substance use, depression, agitation, capacity for medication decision making, and suicidal ideation.
- Interns provide psychiatric and psychological evaluations, short term interventions, and consultation to patients and clinicians on medical and surgical inpatient units throughout the Stony Brook Hospital.

Aug. 2018 – Present, Leonard Krasner Psychological Center (KPC), Stony Brook University

Role: Therapist

Supervisors: Dina Vivian, Ph.D.

- The KPC offers evidence-based treatments, for anxiety disorders, depressive disorders, adjustment disorders, stress related problems, relationship/couple issues, disordered eating, phase of life difficulties, learning difficulties, conduct disorders, ADHD, obesity, pain management, and co-morbidities.
- Interns also provide broad range of psychological assessment services, including comprehensive psychological and/or psycho-educational evaluations for several types of referrals, such as Learning Disabilities; comorbidity of learning difficulties and psychological problems; and diagnostic evaluations for disability determination, mental health clearance, and giftedness.

Aug. 2014 – July. 2018, Adult Anxiety and Trauma Therapy Team, at the University of Wisconsin-Milwaukee Psychology Clinic

Role: Therapist

Supervisors: Shawn Cahill, Ph.D.

- Provided individual therapy to community patients in a low-cost (sliding fee) clinic. The diagnosis of adult therapy patients included anxiety disorders (obsessive-compulsive disorder, generalized anxiety disorder, social anxiety disorder, specific phobia), and depressive disorders. Supervision in cognitive behavioral therapy (CBT) and general factors.

Aug. 2015 – June. 2016, Rogers Memorial Hospital Obsessive-Compulsive Center

Role: Behavioral Specialist

Supervisors: Bradley Riemann, Ph.D., Clinical Director of the OCD Center and CBT Services, Brenda Bailey, Ph.D., OCD Center Supervisor.

- Worked directly with patients in a behavioral specialist role, which included assessment of presenting symptoms, treatment planning, in-vivo and imaginal exposure and response prevention (ERP), attending weekly clinical staffing meetings, and working with patients and staff (psychiatrists, nurses, social workers, residential counselors) through treatment issues and obstacles.

Aug. 2014 – Aug. 2015, Integrative Behavioral Couple Therapy Team, at the University of Wisconsin-Milwaukee Psychology Clinic

Role: Therapist

Supervisors: Christopher Martell, Ph.D., ABPP

- Provided couples therapy as part of a co-therapy team to community patients in a low-cost (sliding fee) clinic. Supervision was obtained in integrative behavioral couple therapy (IBCT) and general factors. Worked with patients to build effective communication skills, empathy, trust, and common goals.

Sept. 2013 – May. 2014, Practicum in Psychodiagnostic and Psychoeducational Assessment, University of Wisconsin-Milwaukee.

Role: Graduate Assessor

Supervisors: Han Joo Lee, Ph.D. & Bonnie Klein-Tasman, Ph.D.

- Administered, scored, and interpreted psychodiagnostic and psychoeducational assessments of children and adults. Assessment included cognitive, attentional, memory, educational, language, sensorimotor, and personality measures. Prepared written reports and provided assessment feedback. Referral questions included differential diagnosis of learning disability, attention deficit/hyperactivity disorder, and emotional disturbance. Received one-on-one, face-to-face supervision. Trained in administration, scoring, and interpretation of the Structured Clinical Interview for DSM-5 (SCID-5), Anxiety Disorders Interview Schedule (ADIS-IV-Lifetime), Mini-International Neuropsychiatric Interview (MINI), Wechsler Adult Intelligence Scale (WAIS-IV), Wechsler Individual Achievement Test (WIAT-III), Minnesota Multiphasic Personality Inventory (MMPI-II), Personality Assessment Inventory (PAI), Personality Assessment Screener (PAS), Depression Anxiety and Stress Scale (DASS-21), Mini-International Neuropsychiatric Interview for Children and Adolescents (MINI-KID), Wechsler Intelligence Scale for Children (WISC-IV), Wechsler Abbreviated Scale of Intelligence (WASI-II), Behavior Assessment System for Children (BASC-II), Gray Oral Reading Tests (GORT-5), Kaufman Brief Intelligence Test (K-BIT-II), , Children's Memory Scale (CMS), Behavior Assessment System for Children (BASC-2), and California Verbal Learning Test (CVLT-II).

Aug. 2009 - June 2012, Center for Anxiety and Related Disorders (CARD) at Boston University

Role: Senior Program Assistant

- Primary responsibility was to conduct brief telephone triage assessments on adult and parents of children requesting services at the CARD. During these assessments, I would conduct a symptom assessment, medical/psychiatric history, treatment history, and a self-harm assessment.
- If the caller was not eligible I would provide appropriate referrals based on their symptom presentation, geographic location, and insurance/financial options.
- Attendance at a weekly clinical meeting where doctoral candidates and clinicians discussed assessment (ADIS-IV), diagnosis, and recommendations for treatment. Assisting therapists with treatment administration (e.g., assisted in the administration of in vivo exposures (e.g. public speaking, needle phobia).

May 2009 – Sept. 2009, McLean Hospital/MGH Obsessive Compulsive Disorders Institute

Role: Behavioral Coach

Director of Training/Supervisor: Szu-Hui Lee, Ph.D.

- Behavioral coaches are assigned one or two patients each morning to coach through their daily ERP. The ERP tasks were developed by licensed psychologists and the role of the behavioral coach was to work directly with the patient, and prompt him/her through the ERP plan and provide instruction, redirection, and encouragement as needed.

Additional Clinical Training: Workshop and Seminars

Sept. 2018 – Present, Leonard Krasner Psychological Center (KPC), Stony Brook University

Instructor: Dina Vivian, Ph.D.

- Provided with a four-part training in Cognitive Behavioral Analysis System of Psychotherapy (CBASP) for depressive disorders. As clinical director and supervisor of the KPC at Stony Brook, Dr. Vivian will provide direct supervision in the implementation of CBASP.

Aug. 2016, Eating Disorders Seminar at the University of Wisconsin-Milwaukee

Instructor: Stacey Nye, Ph.D.

- Dr. Nye led a seminar examining the DSM-5 Feeding and Eating Disorders in the context of assessment, diagnosis and treatment through assigned readings, didactic instruction and audio/visual materials. A biopsychosocial perspective of etiology was examined, including cultural diversity and gender issues. A review of the empirical treatment literature was presented, including several different theoretical perspectives. Videos were presented so students could observe and understand these disorders from more of a real-life perspective. Role play during the seminar was emphasized to practice proper assessment and treatment considerations.

May. 2016, Workshop: Behavioral Activation (BA) for Treating Depression at the University of Wisconsin-Milwaukee

Instructor: Christopher Martell, Ph.D., ABPP

- Dr. Martell, an expert in BA, led a workshop providing the diagnosis of depression, the historical conceptualization of BA, presentation of the tenants of BA treatment, and supervision of role play of assessment and treatment.

Associations:

- Association of Graduate Students in Psychology (AGSIP)

  President - Sept. 2014 – Aug. 2015.

  Vice-President - Sept. 2013 - Sept. 2014

  - Duties included overseeing the general operations, recruitment to the organization, establishing association connection with university faculty, attaining grants for both psychology department graduate student travel and holding a yearly psychology research symposium, and financing the symposium keynote speaker (including travel, housing, and honorarium).

Memberships:

- Anxiety and Depression Association of America (ADAA), 2019
- American Psychological Association (APA), 2017 - Present.
- The Association for Behavioral and Cognitive Therapies (ABCT), 2009 - Present.
- Psi Chi National Honors Society in Psychology, 2009 - Present.

References:

- Han-Joo Lee, Ph.D., University of Wisconsin-Milwaukee 414-229-5858
- Shawn Cahill, Ph.D., University of Wisconsin-Milwaukee 414-229-5099
- Bradley Riemann, Ph.D., Rogers Memorial Hospital 262-646-1388
- Additional references available upon request.